GOVERNMENT OF INDIA

Preinvestment Survey of Forest Resources

25, Subhash Road

DEHRA DUN

CHENAB VALLEY

(Jammu & Kashmir)

VOLUME—I

REPORT ON FOREST RESOURCES

1975-76

Contents

R/NZ-3

GOVERNMENT OF INDIA

MINISTRY OF AGRICULTURE AND IRRIGATION

(DEPARTMENT OF AGRICULTURE)

CHENAB VALLEY

(JAMMU AND KASHMIR)

VOLUME- I.

REPORT ON FOREST RESOURCES

PREINVESTMENT SURVEY OF FOREST RESOURCES

NORTH ZONE.

Contents

P R E F A C E

Preinvestment Survey of Forest Resources started the field work in the Chenab Valley Catchment of Jammu and Kashmir during the year 1970 and although the field work was completed during 1972, yet the report writing has been hanging fire due to one reason or the other. There have been lot of discussions in this connection with Jammu & Kashmir Forest Department but ultimately it was decided to publish the report in the form in which it is now being presented. The report has been published in two volumes. Volume I deals with the result of the Survey and Volume II mainly deals with the methodology adopted. It has to be specially mentioned that in the completion of this report Shri A.P.Dwivedi, Dy. Conservator of Forests Northern Zone had to work very hard because he was new to the Project and was not associated in the field work which was done 5 years ago.

2. The report deals with the surveyed area along with its land use pattern and forest types. Volume tables were then prepared and the total growing stock was computed. The present and future management practices have been discussed and a detailed information on rate of growth is also provided. Market and demand studies were conducted and wood balances have thereby been worked. Besides this, the accessibility and cost studies have been worked and industrial possibilities discussed. As a result of this survey, it is now concluded that besides a large supply of wood in the form of structural wood, railway sleepers etc. after meeting the local requirements, there is a surplus in the catchment which can support major industries of varying scales, i.e. for ground wood pulp manufacture to a tune of nearly 500 tons per day capacity or a chemical pulp mill (rayon grade) of the capacity of nearly 170 tons per day. The State Government can now, on the basis of these results, carry out further feasibility studies with a view to working out the possibilities of installation of a big industry in the State based on wood resources.

Dehra Dun
Dated: 8.3.1976.

ROMESH CHANDRA
Chief Coordinator

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CHENAB VALLEY (J & K)

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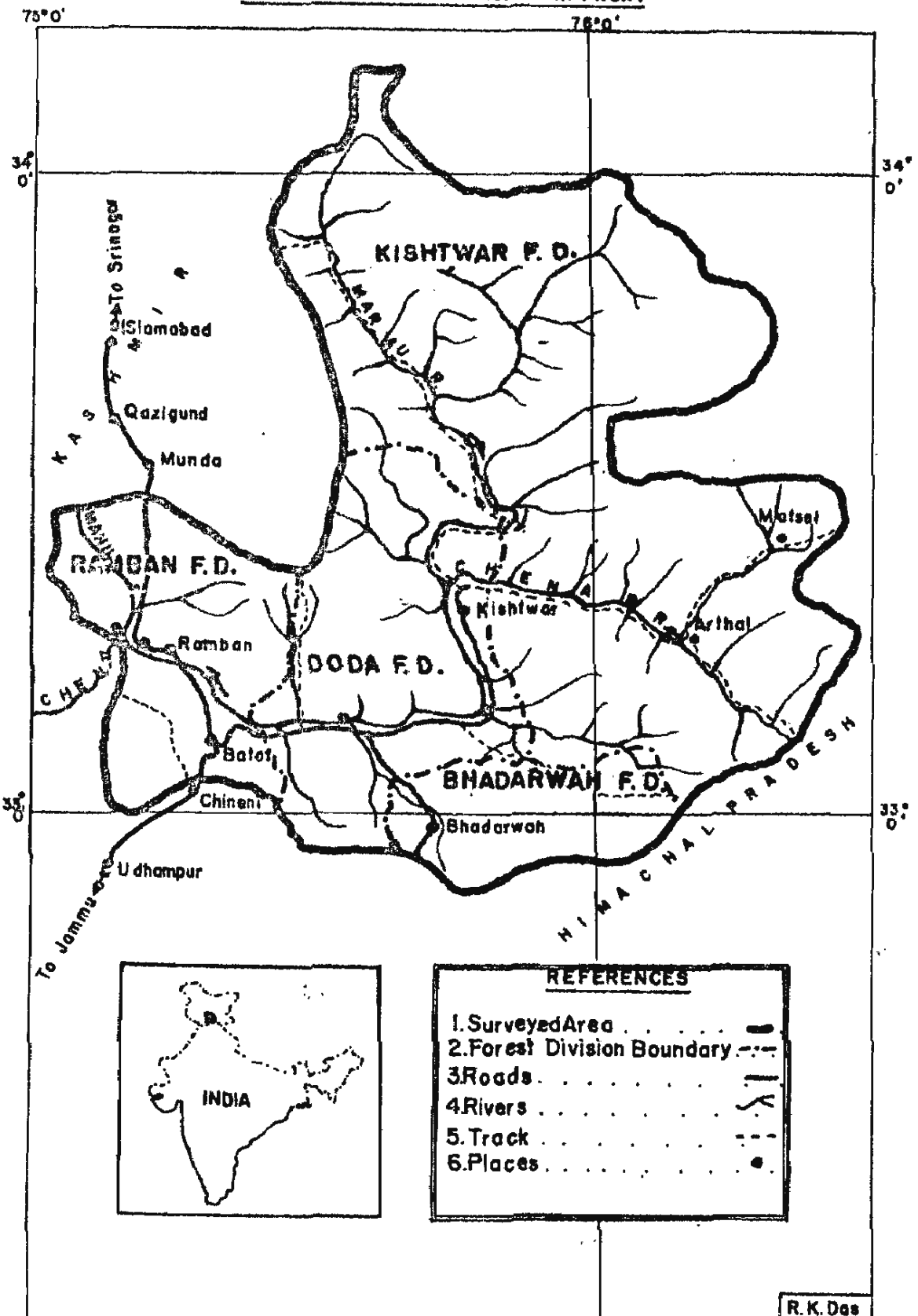

CHAPTERWISE

S U M M A R Y

Note:- Volumes are Wood Round Equivalents

(WRE)

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SUMMARY

C H A P T E R - I

THE BACKGROUND

1. Total geographical area covered by the Pre-investment Survey in the Chenab Valley of Jammu and Kashmir State is 9846.23 sq. kms.

2. The Survey area is situated between latitude 32°50' N to 34° 10' N and longitude 75°E/to 76° 25' E approximately.

3. The entire area is mountaineous and the elevation ranges from 736 metres to over 6790 metres above M.S.L. The bulk of the forests lie between elevations of 800 metres to 3000 metres.

4. There is a variety of geological formations occuring in the area. The soil varies from sandy to sandy loam and clay at places.

5. Annual rainfall varies from 100 cms. to 150 cms. in the area.

6. Roads are a few and there are no railways in the area. Timber is, therefore, normally transported by water.

7. Local population is entirely engaged in agricultural or pastoral pursuits.

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SUMMARY

C H A P T E R- II

SURVEY OBJECTIVES AND METHODOLOGY

OBJECTIVES:

1. (i) To prepare an Inventory of the Forest Resources.

(ii) To carry out accessibility and Cost Studies.

(iii) To undertake Demand and Market Studies.

PRECISIONS:

2. The estimates of the total forest area and the total growing stocks were aimed to be within 1% and 5% (Standard error) respectively.

ACCESSIBILITY AND COST STUDIES:

3. To find out the economic availability of raw materials for the establishment of wood based industries, particularly pulp and paper, accessibility and Cost Studies were conducted.

DEMAND AND MARKET STUDIES:

4. To ascertain the present level and patterns of consumption of wood locally, Demand and Market Studies were also conducted. The future demand of local population has been projected on the basis of population and their demand growth.

METHODOLOGY:

5. Systematic cluster sampling has been used for forest inventory. Area estimates under different land uses were obtained from interpretation of aerial photographs.

6. The methodology has been discussed under relevant chapters. Details are given in Volume II of the Report.

7. The data was mainly processed using the IBM/1620 Model II Electronic Data Processing System.

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C H A P T E R - III.

LAND USE PATTERN AND FOREST TYPES

1. As a result of 100% interpretation of aerial photographs the present land use pattern is as follows:-

Sl.No.	Land Class.		Area (Sq. Km.)
(i)	Forest Land		
	a) Vegetation-forests.	..	3744.33
	b) Vegetation-scrubs etc.	..	292.07
(ii)	Farm Woodland.	..	276.28
(iii)	Non-forestry plantations.	..	47.36
(iv)	Agricultural Crop Lands.	..	718.33
(v)	Pasture Lands.	..	726.23
(vi)	Urban Village and Industrial Lands.	..	47.36
(vii)	Barren Lands.		3710.09
(viii)	Others.	..	284.18
		Total:	9846.23

2. For tabulation purposes different forest types were grouped together into five strata namely Chir Pine, Blue Pine, Deodar, Fir and others(mainly broad leaved)

3. Total forest area as obtained from the interpretation of aerial photographs was accepted as the basis. For further break-up into Forest types, it was calculated on the basis of the proportion of ground samples occuring in the particular forest strata.

4. Area under different forest strata is as follows:-

Sl.No.	Stratum		Area (Hectare)
(1)	Chir	..	19,396
(2)	Kail	..	73,369
(3)	Deodar	..	65,779
(4)	Fir	..	132,401
(5)	Others(mainly broad leaved)	..	83,488
		Total:	3,74,433

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C H A P T E R - IV.

VOLUME TABLES AND GROWING STOCK
(in groups)

394 trees of different species/were felled for the construction of Volume tables. Multiple regression equations were tried between volume, diameter and height in respect of general volume equations and between volume and diameter in case of local volume equations. Local volume tables have been prepared for Chir, Kail, Deodar, Fir and miscellaneous Broad leaved species.

2. Area and growing stock figures by different forest strata are as under:-

Sl.No.	Stratum	Area (hectares)	Growing stock volume ('000' m^3)	% Volume
(i)	Chir	19 396	2473.2	2.4
(ii)	Kail	73 369	15057.6	14.8
(iii)	Deodar	65 779	24914.5	24.5
(iv)	Fir	1 32 401	46525.7	45.7
(v)	B.L. & others.	83 488	12885.6	12.6
	Total:	3 74 433	1,01,856.6	100.00

3. Cull in Chir and Deodar is negligible (less than 1%) and, therefore, no reduction for cull in respect of these species has been made. In case of Kail cull percentage was 4.5 and hence a deduction of 5% was made whereas in case of fir and spruce, Cull percentage varied from 5% to 28% from middle age onwards. To be on safe side therefore, a reduction of 30% has been made to find out net volume of fir and spruce.

4. Net growing stock of important species (after deduction of cull) is as under:-

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SUMMARY

Sl.No.	Species	Volume Gross ('000' m^3)	Net volume after deduction of cull ('000' m^3)
(i)	Chir	2,403.5	2,403.5
(ii)	Blue Pine	17,905.5	17,010.2
(iii)	Deodar	24,474.6	24,474.6
(iv)	Fir/Spruce	42,690.7	29,883.5
(v)	Ban-Oak	1,041.0	1,041.0
(vi)	Others	13,341.3	13,341.3
	TOTAL:	1,01,856.6	88,154.1

(This is volume of individual species and is, therefore, different when compared to strata figures though the name of the strata is the same in some cases).

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SUMMARY

C H A P T E R -V.

MANAGEMENT PRACTICES, PRESENT & FUTURE PROPOSALS.

1. The forests are being managed primarily with a view to conserving soil and moisture, to meet the bonafide domestic and agricultural requirements of the local people for timber, fuelwood and fodder; and to obtain progressively increasing yield of timber, keeping in view all the former objectives.

2. The timber production, after meeting the requirements of the local populace, aims at growing large sized trees for conversion into railway sleeper sizes (scantlings 300 cm. x 25 cm. x 12.5 cm). Deodar, although not used for Railway sleepers any more, yet is converted in the above standard sizes.

3. The accessible Deodar and Kail forests are being managed mostly under Shelter wood System whereas Fir/Spruce forests and inaccessible forests are being managed under Selection System (Except in Doda Division where both modified Shelterwood System and Selection System are in vogue).

4. Large sized timber for construction and railway sleepers (few species) may continue to be in demand for a long time to come. Some of the forests may, therefore, continue to be managed for production of large sized timber.

5. Keeping in view the concept of economic planning and the requirement of the country in respect of pulp, the forests may have to be worked under shorter rotations.

6. Silvicultural Systems to be used will depend upon the requirement of the site and the species.

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C H A P T E R - VI.

RATE OF GROWTH AND STEM DISTRIBUTION.

1. Stem analysis was carried out on the felled coniferous trees. This yielded the following results:-

TABLE- VI-5

Diameter (cms)	SPECIES							
	FIR AND SPRUCE		BLUE PINE		DEODAR		CHIR	
	Age (Yrs)	Height (M)	Age (Yrs)	Height (M)	Age (Yrs)	Height (M)	Age (Yrs.)	Height (M)
10	-	-	-	-	-	-	-	-
20	-	-	52	16	68	17	-	-
30	95	25	66	24	79	25	62	22
40	125	28	78	29	89	30	71	27
50	153	33	89	33	100	35	79	29
60	179	38	100	35	111	35	84	30
70	201	42	111	38	122	37	89	31
80	220	45	124	40	134	38	-	-
90	238	48	138	41	144	39	-	-
100	254	49	-	-	-	-	-	-

2. For study of stems distribution Table Nos. 6-10 of Chapter VI may be referred to. This reveals that all diameter classes are rather well represented in case of fir, deodar and others strata whereas in case of Blue - Pine and Chir lower diameter classes are not adequately represented.

3. Mean age and mean Annual Increment corresponding to mean age of the species of Chir, Kail, Deodar and Fir in the strata of Chir, Kail, Deodar and Fir respectively works out approximately as under:-

Stratum	Species	Mean age in years	Mean Annual Increment (per hectare/m^3)
Chir	Chir	80.3	1.54
Blue-pine	Kail	94.8	1.77
Deodar	Deodar	104.0	3.01
Fir	Fir/Spruce	165.0	1.77

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SUMMARY

C H A P T E R- VII.

POTENTIAL ANNUAL CUT.

1. Two cutting Models have been considered. Model I aims at the production of large sized trees to meet with the requirement of railway sleepers. Model II is to produce raw materials for pulp and paper industry and manufacture of fruit packing cases.

2. Annual Potential Cut for all the conifers under the two Models is as follows:-

Species	Annual Cut	
	Model I (m^3)	Model II (m^3)
Chir	39,000	49,300
Blue-Pine	2,07,000	2,78,000
Deodar	0,03,000	3,03,000
Fir/Spruce	2,83,200	3,56,300

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C H A P T E R- VIII

MARKET AND DEMAND STUDIES

1. The object of this study was to work out the present level of wood production and consumption and to project the demand for the year 1981 and 1991.

2. The current annual production of wood from the survey area is 2,50,867.26 cubic metres (WRE). The species and gradewise break-up is given in the following table.

Item	Deodar	Kail	Fir/ Spruce	Chir	Mixed conifers	B.L.	Others	TOTAL.
Timber	68068.86	58828.71	84464.77	2177.81	15239.36	243.42	121.85	229142.78
Fire-wood	2026.00	1520.00	9960.00	207.00	-	8011.48	-	21724.48

Out of the total production, the production from Govt. Forests, Private Forests and Revenue Forests is 98.37%, 1.60% and 0.03% respectively.

3. The valley with a population of 3,41,858 (1971 census) consumes only 3.70% of the total production of the zone mainly for house construction and for fuel (as reported by the Forest Department).

4. Besides the consumption by local people for house construction and fuel (mentioned above), the fruit boxes and a few small furniture production units consume 1.8% of the total production of wood.

The following table shows the present consumption pattern of wood.

CONTD.....

TABLE NO. VIII-15.

SHOWING AVERAGE ANNUAL CONSUMPTION OF TIMBER AND FUEL

WRE(Cubic meters)

Sl. No.	Use	Deodar	Kail	Fir/ Spruce	Chir	B.L	TOTAL.
1.	Construction and repair of houses.	19,389.48	4,847.37	-	-	-	24,236.85
2.	Agricultural implements.	-	-	-	-	6,984.06	6,984.06
3.	Fuel(recorded)	2,026.00	1,520.00	9,960.00	207.00	8,011.00	21,724.00
4.	Industry.	1,116.33	2,295.74	639.17	190.75	369.72	4,611.71
5.	Other Department.	141.52	51.75	18.35	27.93	-	239.55
6.	Railway and D.G.S & D.	3,191.28	307.05	5,448.85	924.48	-	9,871.66
	TOTAL:	25,864.61	9,021.91	16,066.37	1350.16	15,364.78	67,667.83

5. 94.50% of the total production is exported outside the zone mainly to the timber market at Jammu for end use as construction timber railway sleepers etc; in the plains of the country.

6. The consumption during 1970-71, projected demand for the year 1981 and 1991 taking into consideration the growth in population, increase in per capita income, prices etc. are shown in Table given below:-

CONTD.....

CHAPTER-VIII. SUMMARY

A. Timber

	Units	Cubic metres (WRE)	
Species	1970	1981	1991
Chir	1143	1760	2713
Kail	7502	10158	13975
Deodar	23839	31340	41200
Fir/Spruce	6106	9425	14388
Broad leaved	7354	9637	12745
TOTAL:	45944	62320	85021

B. Fuel Wood

Chir	207	319	495
Kail	1520	2316	3572
Deodar	2026	3048	4659
Fir/Spruce	9960	16997	26267
Broad leaved	8011	11991	18671
TOTAL:	21724	34671	53664
GRAND TOTAL:	67868	96991	138685

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C H A P T E R -IX.

WOOD BALANCES

1. The present consumption and the projected demand for timber and fuelwood in the survey area is as under:-

Species	Years		
	1970	1981 (in m^3)	1991
Chir	1350	2079	3208
Kail	9022	12474	17547
Deodar	25865	34388	45859
Fir/Spruce	16066	26422	40655
Broad Leaved	15365	21628	31416
TOTAL:	67,668	96,991	1,38,685

2. The wood balances of Chir, Kail and Fir-Spruce, after meeting with these requirements under the two Models is as under:-

Model	Years		
	1970	1981 (Volume in '000'm^3)	1991
I	503	489	468
II	657	643	622

(Deodar and broad leaved species has been ommitted in these calculations on the assumption that it will not at all be available for pulp and paper).

3. It may take 10 to 15 years to establish a pulp and paper or any other industry. Therefore, the volumes as available in the year 1991 should only be considered for industrial purposes. Further, whole of these quantities may not be available for utilisation on account of silvicultural considerations, in-accessibility, inefficient logging and several other factors. To be on the conservative side it is presumed that only 50% of this wood will be available for industrial purposes. Thus the quantities available under these two models will be as follows in the year 1991.

Model	'000' m^3
I	234.00
II	311.00

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C H A P T E R -X.

ACCESSIBILITY AND COST STUDIES

1. The main object of this study was to find out economic availability of wood raw-materials for establishment of wood based industries at Jammu.

2. Presently the commercial extraction is confined only to the coniferous species. Marking of trees in the coupes is done; the marked trees are sold to the contractors, who extract the timber sizes according to the demand in the market.

3. Conventional tools are used for the extraction of wood. The trees are converted into sleepers and hakaries at site. They are brought down to launching/load points through any one or a combination of more than one mode of minor transport, like manual carriage, dry slide, wet slide, telescopic floating and/or Donald gravity ropeways.

4. Chenab and Marau are two important rivers used for free floating of logs as well as scantlings. Rivers/and streams floating is extensively practised in the area, because of inadequate road net work.

5. The study has been designed on a systematic pattern. Block centre of each block of ground sampling of ground sampling design has been taken as starting point for extraction. It has also been considered as the point of origin for compiling transport distances. Case studies from 25 logging coupes, representing the entire range of variations, in topography and working conditions in the survey area were taken up. With the help of carefully designed questionnaire and proformas, specially trained crews interviewed the forest lessees and sub-contractors engaged in the logging work.

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6. The summary of logging costs for various operations per Cubic metre of wood is as under:-

Sl.No.	Item	Average Cost/M^3 (in Rupees)
1.	Marking of trees.	0.025 (Standing Volume)
2.	Felling (including lopping and ropping).	1.17 (Standing Volume.
3.	Bucking (Delimbing, cross-cutting and debarking).	3.92 (Logs Volume)
4.	Sleeper conversion	
	i) By hand sawing.	33.26 (Sawn Volume)
	ii) By machine sawing.	21.79 (Sawn Volume)
5.	Hakari making.	12.92 (Split Volume)
6.	Engraving property mark.	
	i) Sleepers / Hakaries	0.30 (Scant volume)
	ii) Logs	0.18 (Log Volume)
7.	Minor transportation:	Av. cost/M^3/Km.
	i) Rolling (logs only)	7.87
	ii) Manual carriage	8.62
	iii) Dry slide	3.83
	iv) Wet slide	1.94
	v) Telescopic floating.	1.31
	vi) Donald Gravity Ropeway.	2.60(Span 750 metres and more)
	vii) Donald Gravity Ropeway.	4.49 (Span less than 750 metres)
	viii) Power Ropeways.	3.89
8.	Major transportation:-	
	i) Free floating	
	(a) Logs	0.08
	(b) Sleepers/Scantling/ Hakaris:-	
	1) Lead below 100 Kms.	0.15
	2) Lead of 100 Kms and more.	0.06

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ii) Truckings:

(a)	1-15 Kms. lead	0.53
(b)	16-30 Kms. Lead	0.36
(c)	31-45 Kms. lead	0.31
(d)	46-60 Kms. lead	0.28
(e)	60-90 Kms. lead	0.26
(f)	90-120 Kms. lead	0.24
(g)	121-150 Kms. lead	0.23
(h)	151-180 Kms. and above lead.	0.23

9. Amenities to labour — 10% on all items from 2 to 7 (i to vii) above.

10. Over-head charges — 1% on items 1 to 8.

Distribution of volume (growing stock) and its percentage by different cost classes for delivery at Jammu under various alternative is as under:-

Cost Class (Rupees)	% volume in cost class if extracted as				
	Logs	Logs where possible and sleepers elsewhere	Logs where possible and Hakaris elsewhere	Sleepers	Hakaris
(1) Below 70	100.0	33.4	78.7	6.1	78.7
(2) 70-100	-	44.7	21.3	68.2	21.3
(3) Above 100	-	21.9	-	25.7	-

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C.H A P T E R -XI.

INDUSTRIAL PROPOSALS

Assuming 1.5 cubic metres of wood equivalent to one tonne in weight and 300 days of production in a year, the following pulp mills with the capacities can be installed:-

TABLE XI-1.

Capacity of pulp mills in tonnes/day based on raw materials available under the two Models.

Sl. No.	Kind of pulp	Yield	Capacity in tonnes/day Model I	Model II
1.	Ground wood	90%	468	621
2.	Semi Chemical	70%	364	483
3.	Chemical (Kraft)	40%	208	276
4.	Chemical (Rayon Grade)	30%	156	207

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C H A P T E R- XII.

RECOMMENDATIONS

1. Sufficient wood raw materials are available for installation of one Pulp and Paper Mill for production of any one category of pulp as indicated in Chapter XI.

2. Since cull in case of Blue-pine and Fir and Spruce has been found to be abnormally high (up to 28% in higher diameter classes) it is recommended that this stock and over mature trees should be removed as early as possible.

3. Means of communication should be improved and mechanised devices for logging should be introduced.

4. Artificial means of regeneration should be adopted in Fir/Spruce and Kail Forests, and also Deodar and Chir where necessary, as natural regeneration may not be able to cope with the large scale felling for pulp and paper mill.

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C H A P T E R-I.

T H E S U R V E Y A R E A

General Information

1. NAME:

Chenab Valley, the survey area, is the catchment of river Chenab and its tributaries flowing in the State of Jammu and Kashmir. This area will be referred to, in the report, as the ' valley' or the 'area'.

2. AREA:

The total geographical area of the Valley covered by survey is 9,846 sq. kms.

3. LOCATION:

The Valley lies between the latitudes of 32° 50' N to 34°-10' N and the longitudes 75° E to 76° 25' E approximately. 29 maps (1:50,000) in Sheet Nos. 43, N, O & E and No. 52 C & D of Survey of India, cover the area.

4. SITUATION:

The Valley lies in the Doda Civil District of Jammu & Kashmir, from southern enterance of Jawahar Tunnel to the border with Chamba District of the State of Himachal Pradesh. It is separated from Suru and Zanskar area of Ladakh District of Jammu & Kashmir, and Kashmir Valley, by the great Himalayan Pir Panjal range.

The area covers Ramban, Doda, Bhadarwah and Kishtwar Forest Divisions.

5. TOPOGRAPHY:

The area is mountaineous except along the banks of river and stream where flat bits of the land are met with. The elevations vary from 736 metres above M.S.L., at Ramban, to 6790 metres, at Nun-Kun, on Suru border. General elevations are around 2000 metres to 3000 metres above M.S.L. peaks and main ridges are mainly above 3,500 metres. Slopes are steep to very steep. The streams are characterized by bouldery beds.

The forests lie mostly between 800 metres to 3000 metres.

6. GEOLOGY:

Due to great variation in the altitudes and mountain ranges, a wide variety of geological formations are met with in the area. In Ramban Forest

CONTD.....2

Division the main formations, Upper Shiwaliks, Murrees and Nummalites, consist of Conglomerates, sandstones, clays, shales and lime stone. Agglomeratic slates, Panjal Traps, Ganga moptris beds and Triassic formations cover Doda Forest Division. Cambro-Silurian rocks, with igneous intrusions, are common in Bhadarwah Forest Division whereas a variety of inner Himalayan rock formations are met with in Kishtwar Forest Division. Valuable minerals e.g. saphires are found in Paddar range.

7. SOIL:

Weathering of Upper Siwaliks, Murrees and Shaly portion of Nummulites gives rise to the soils which are mostly sandy and clayey in nature whereas the soils derived from Panjal traps and Agglomeratic slates, Dogra slates and Salkhalas is mostly silty.

In Ramban Forest Division, the soil, therefore, varies from sandy to sandy loam and clayey at places. Mica Schist found in Doda end right upto Udil gives excellent deep loam of first quality. Deep sandy loam soil occurs on volcanic rocks whereas it (soil) is shallow on slates and shales. In Bhadarwah and Kishtwar Division the typical soil produced by decomposition of mica chists and granite is loose sandy loam. The soil overlying slates on dip slopes is rather shallow. In Kishtwar, sandy soil is also met within upper valleys.

8. CLIMATE:

The climate in the area is temperate with very severe winters. Summers are mild except in the areas along river beds in the lower reaches, which become very hot.

9. RAIN AND SNOW:

The area gets regular rains from the North West Monsoons, from end of June to the middle of August. Occasional showers, due to local disturbances, are experienced from middle of March to middle of April, sometimes extending upto May.

Annual rainfall varies from 1000 mm to 1500 mm. Monsoons shed most of the moisture in the outer ranges, when they enter the valley, the rainfall decreases as they approach the Pir Panjal Range.

In the higher reaches of the Valley, 50% of annual precipitation is in the form of snow. The forests and the valley 800 metres above M.S.L. remain show-bound from November till the end of March.

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10. INFRA-STRUCTURE FOR WOOD TRANSPORT:

(i) Railways: There are no railways in the surveyed area. The nearest rail-head is Jammu (Tawi) at a distance of 121 Kms. by road from Batote.

(ii) Roads:- The following roads exist within the valley:-

(1)	Jammu- Srinagar Highway (Batote to Jawahar Tunnel)	66 Km.
(2)	Batote to Kishtwar	108 Km.
(3)	Doda to Bhadarwah	32 Km.

The road network is inadequate for transport of wood. Road construction in the area is very costly. No large scale or important road building activity is envisaged in near future.

(iii) Streams & Rivers:- Streams and rivers are the main and the cheapest means of transport of timber in the area. From the forests, and side streams, logs, sleepers and hakaries are floated or brought to the main rivers by chutes, slides (wet and dry) and telescopic floating. Free floating of logs and scantlings is done in Marusdar and Chenab rivers. Most of the timber extracted from the forests of the area is floated in Chenab river, and caught at Ramban or Akhnoor. The boom at Ramban is not suitable for catching logs. From boom heads, to the sale centres, Jammu and Pathankot the timber is transported in trucks. Road distance from Ramban to Jammu is 153 Kms., Akhnoor to Jammu 32 Kms. and Jammu to Pathankot 108 Kms.

Water transport though improves the timber by water seasoning yet it takes a long time, and result in river losses. Truck transport, though more expensive than water transport, is preferred for quick turn over of investment and no losses during transit.

11. THE PEOPLE:

Total population of the valley according to 1971 census is 3,41,858. The people are mostly engaged in agriculture and pastoral pursuits. Mainly maize, barley and wheat are grown; rice is cultivated where irrigation is possible.

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The people rear sheep and goat and graze their cattle. They move to higher altitudes in summer and come back to the lower areas in winter with their herds. Some of them have a second set of houses, away in the forests called ' Chaks' or ' Dhars'. These are maintained primarily for grazing their cattle, but cereals and other crops are also raised on the lands near these ' Chaks'.

The valley has the lowest literacy percentage in the State of Jammu and Kashmir. Only 8.6% of its population was literate in 1961 as against 11% for the whole state. In the rural population, which form 94% of the population, the incidence of literacy is still lower.

People depend on forests practically for everything such as fuelwood, timber, grazing of their cattle and earning money by working in forests, during spare time, on different forestry operations. People also get employment on road construction and repair works in Public Works and Forest Departments.

Per capita income in the valley is Rs. 260.00 (1961 Census) as compared to Rs. 293.80 for the whole of Jammu and Kashmir State at 1955-58 price level.

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C H A P T E R-II.

I N V E S T I G A T I O N & M E T H O D O L O G Y.

INVESTIGATIONS:

The survey carried out the following investigations:-

(1) Prepared Inventory of the Forest Resources.
(2) Accessibility and Cost studies.
(3) Demand and Market studies.

2. INVENTORY OF THE FOREST RESOURCES:

The main objective for the inventory of the forest resources were:-

(a) to estimate the total area under forests and other important land uses.

(b) to estimate forest area under different forest types.

(c) to estimate the total growing stock and its distribution under important forest types.

(d) to estimate growth rate and carry out cull for important forest species.

(e) to calculate Annual Potential cut under alternative management practices, and

(f) to prepare forest type map for management and planning.

Precision:- The estimates of the total forest area and the total growing stock aimed at were to be with a standard error of 1% and 5% respectively.

3. DEMAND AND MARKET STUDIES:

The objectives of this study were:-

(a) to find out the present level and pattern of wood consumption and

(b) to project the demands of wood for future requirements.

4. ACCESSIBILITY AND COST STUDIES:

This study was conducted in order to find out the economic availability of raw materials for the establishment of wood based industries especially

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pulp and paper. The tentative delivery site was fixed at Jammu.

5. METHODOLOGY:

(i) Forest Inventory:- Please refer to the Technical Report on Data Processing in volume II of this Report.

(ii) Interpretation of Aerial Photographs:- Aerial photographs on the scales 1:40,000 and 1:60,000 taken during October, 1961 and June, 1965 respectively were available for interpretation at the time of survey. Except for small gaps the entire survey area was covered by aerial photography. The existing gaps in aerial photography were covered by Helicopter flights.

Aerial photography was used in order to find out:

(a) area under forest, scrub and non-forest lands.

(b) estimate of area under different forest types(This could not be done because of the small scale of photography) and

(c) to prepare forest types map for management and planning.

100% interpretation was carried out on alternate photographs. Minimum area for delineation of a forest type or any other land use class was 10 hectares. The details are given in the Technical Report No. III- Photo-interpretation, in Volume II.

(iii) Market and Demand Studies:- Sample surveys were conducted and available data compiled. Please refer to Chapter VIII of this Report for details.

(iv) Accessibility and Cost Studies:- Systematic sampling design was adopted for this study also. Block centres, as per inventory ground sampling design, were treated as the basic units of samples. Various details regarding extraction of wood were collected for these samples. The details are given in Chapter 'X' of this Report.

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C H A P T E R-III.

LAND USE PATTERN AND FOREST TYPES

1. LAND USE PATTERN:

On the basis of 100% interpretation of aerial photographs present land use pattern was found to be as follows:-

TABLE NO. III-I.

AREA UNDER DIFFERENT LAND USES

Sl. No.	Land Use	No. of plots.	Area (Sq. Kms.)	Percentage.
1.	Forest lands.			
	(a) Vegetation-forests.	444	3,744.33	38.0
	(b) Vegetation-scrubs etc.	37	292.07	3.0
2.	Farm wood land.	35	276.28	2.8
3.	Non-forestry plantations.	6	47.36	0.5
4.	Agricultural crop lands.	91	718.33	7.3
5.	Pasture lands.	92	726.23	7.4
6.	Urban, Village and Industrial lands.	6	47.36	0.5
7.	Barren lands.	470	3,710.09	37.7
8.	Others.	36	284.18	2.8
	All land Uses.	1,217	9,846.23	100%

2. SPECIES GROUPING:

For tabulation, different forest types were grouped together and the following five strata were formed:-

Stratum	Forest types in the stratum
Fir	Fir, Fir-Blue Pine.
Blue-pine	Blue-pine, Blue Pine-Fir.
Deodar	Deodar
Chir-pine	Chir pine
Others	Mostly Broad-leaved.

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3. BREAK-UP OF TOTAL FOREST AREA INTO DIFFERENT STRATA:

100% aerial photointerpretation gave out total forest area as 3,74,433 hectares. Correspondingly, by ground sampling and photointerpretation, 444 plots fell in forests and open forests. The area weightage per plot was calculated as $\frac{374433}{444}$ = 843.32 hectares. For further calculation of areas under any stratum, the number of plots in that stratum are multiplied by this weightage.

4. AREA BY FOREST DIVISIONS AND FOREST STRATA:

Number of plots in each forest stratum and each Forest Division are tabulated as below:-

TABLE NO. III-2.

NUMBER OF PLOTS BY STRATUM AND FOREST DIVISIONS.

Stratum	Forest Division					
	Kishtwar	Bhadarwah	Doda	Ramban	Udhampur*	Total
Fir	67	41	39	10	0	157
Blue pine	30	10	30	17	0	87
Deodar	20	33	20	5	0	78
Chir pine	0	1	1	18	3	23
Others	48	14	20	16	1	99
TOTAL:	165	99	110	66	4	444

* Being a very small area, it has generally been omitted from the report.

5. Areas by forest strata and Forest Divisions thus work out as under:-

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TABLE NO. III-3.

AREAS BY FOREST STRATA AND FOREST DIVISIONS

(Hectares)

Stratum	Forest Division					Total.
	Kishtwar	Bhadarwah	Doda	Ramban	Udhampur	
Fir	56,502.28	34,575.95	32,889.38	8,433.18	0	1,32,400.79
Blue Pine	25,299.53	8,433.18	25,299.53	14,336.40	0	73,368.64
Deodar	16,866.35	27,829.48	16,866.35	4,216.59	0	65,778.77
Chir Pine	-	843.32	843.32	15,179.72	2,529.95	19,396.31
Others	40,479.24	11,806.45	16,866.35	13,493.08	843.32	83,488.44
Total:	1,39,147.40	83,488.38	92,764.93	55,658.97	3,373.27	3,74,432.95 or 3,74,433.

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CHAPTER- IV.

VOLUME TABLES AND GROWING STOCK.

PREPARATION OF VOLUME TABLES:

No. of trees felled for preparation of volume tables were:-

Chir	36
Blue Pine	93
Deodar	136
Fir/Spruce	90
Others	39
TOTAL:	394

2. Multiple regression equations for measured volume of the trees to their diameters (o.b. at B.H.) and total heights (standing) were fitted. The general volume equations and the local volume equations fitted are given in Technical Report on Data Processing in Volume II of this Report.

3. Local volume tables prepared for different species are reproduced below:-

TABLE NO. IV- 1.

(Dia Metre)	Volume (m^3)/(U.B)				
	Chir	Kail	Deodar	Fir/Spruce	Broadleaves
.10	.020	.088	.109	.067	.116
.15	.055	.120	.169	.113	.122
.20	.150	.215	.287	.225	.177
.25	.304	.373	.465	.405	.281
.30	.519	.594	.702	.652	.435
.35	.793	.879	.998	.966	.638
.40	1.127	1.227	1.353	1.348	.890
.45	1.520	1.637	1.766	1.796	1.191
.50	1.974	2.112	2.239	2.312	1.542
.55	2.487	2.649	2.771	2.895	1.943
.60	3.060	3.249	3.362	3.545	2.393
.65	3.692	3.913	4.012	4.262	2.892
.70	4.385	44.639	4.721	5.047	3.440
.75	5.137	5.429	5.489	5.898	4.038
.80	5.949	6.282	6.316	6.817	4.685
.85	6.820	7.198	7.202	7.803	5.382
.90	7.752	8.177	8.148	8.856	6.128
.95	8.743	9.220	9.152	9.976	6.923
1.00	9.794	10.325	10.215	11.164	7.767
1.05	10.904	11.494	11.337	12.418	8.661
1.10	12.075	12.725	12.518	13.740	9.605
1.15	13.305	14.021	13.758	15.129	10.597
1.20	14.595	15.379	15.058	16.585	11.640

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4. GROWING STOCK:

Using these volume tables on plot enumeration data, plot volumes were calculated. These plot volumes were grouped together in each forest type stratum and figures for volume per hectare in each stratum were computed. Details in " Technical Report on Data Processing"- Volume II.

Following table gives the area, volume per hectare, their S.E. % and total volume in each forest type:-

TABLE NO. IV- 2.

Total surveyed Area = 984623 Ha. Total forest area = 374433 hec.

Total No. of Blocks in surveyed area = 158 Total No. of forest Blocks. = 102

Total No. of plots in surveyed area = 1217 Total No. of forested plots = 444

Stratum	Area (Ha.)	% Area	S.E. %	Vol./Ha. cu.m.	S.E %	Total Vol. '000' cu.m.	% Vol.	No. of plots Total	No. of plots Enumerated
Fir	132401	35.3	8.8	351.40	7.6	46525.7	45.7	157	134
Blue-pine.	73369	19.6	8.5	205.23	10.5	15057.6	14.8	87	81
Deodar.	65779	17.6	13.4	378.76	6.4	24914.5	24.5	78	72
Chir-pine	19396	5.2	12.7	127.51	16.0	2473.2	2.4	23	19
Others.	83488	22.3	7.2	154.34	10.8	12885.6	12.6	99	77
Total:	374433	100		272.02	6.01	101856.6	100	444	383

5. Distribution of Growing stock/Hectare:-

The distribution of volume per hectare by different stratum and by important species is tabulated below:-

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TABLE NO. IV-3.

DISTRIBUTION OF VOLUME/HECTARE BY IMPORTANT SPECIES.

Stratum	Volume in m^3						
	Chir	Kail	Deodar	Fir/ Spruce	Ban- oak	Other broad leaved	TOTAL.
Fir	0.06 (0)	17.27 (4.9)	13.35 (3.8)	291.94 (83.1)	0.00 (0)	28.78 (8.2)	351.40 (100)
Blue Pine	0.00 (0)	168.10 (81.9)	20.26 (9.9)	9.02 (4.4)	1.21 (.6)	6.64 (3.2)	205.23 (100)
Deodar	0.00 (0)	35.10 (9.3)	318.68 (84.1)	14.69 (3.9)	2.76 (.7)	7.53 (2.0)	378.76 (100)
Chir	123.51 (97.0)	0.00 (0)	0.00 (0)	0.00 (0)	2.11 (1.6)	1.89 (1.4)	127.51 (100)
Others	0.00 (0)	11.70 (7.6)	3.09 (2.0)	28.86 (18.7)	8.74 (5.7)	101.95 (66.0)	154.34 (100)

The figures in brackets show the percentage of volume under the species with respect to the total volume per hectare.

6. DISTRIBUTION OF TOTAL GROWING STOCK BY STRATA AND IMPORTANT SPECIES:

The distribution of total growing stock by different stratum and important species, therefore worksout as under:-

TABLE NO. IV-4.

DISTRIBUTION OF TOTAL GROWING STOCK BY FOREST STRATA AND IMPORTANT SPECIES.

Stratum	Volume in '000 m^3						
	Chir	Kail	Deodar	Fir/ Spruce	Ban- oak	Other Broad leave	Total
Fir	7.9	2,286.6	1,767.6	38,653.1	0	3,810.5	46,525.7
Blue-pine	0	12,333.3	1,486.5	661.8	88.8	487.2	15,057.6
Deodar	0	2,308.8	20,962.5	966.3	181.6	495.3	24,914.5
Chir pine	2395.6	0	0	0	40.9	36.7	2,473.2
Others	0	976.8	258.0	2,409.5	729.7	8,511.6	12,885.6
TOTAL:	2403.5	17,905.5	24,474.6	42,690.7	1041.0	13341.3	1,01,856.6

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7. CULL:

Cull means the natural defects in wood which make it unsuitable for any utility purposes. Here, in this report, it refers to rot, hollowness and knots in the wood. Loss of volume in wood due to these defects will be called cull volume and the factors which determine the cull volume in standing trees are known as cull factors.

(i) Determination of Cull factors:- The data for cull was collected from the felled trees, and analysed. For each of the important forest species cull volume was expressed as percentage of gross volume for each diameter class of trees. For each of the 10 cm. diameter classes, percentages of Cull were plotted on a graph paper. It was noticed that these plotted volumes do not always follow any particular trend. For each of the 10 cm. diameter classes, percentage for cull volume were read and tabulated. These volumes were applied to the total growing stock to give allowance for the cull while calculating net growing stock of the important forest types. Cull factors for different important species are described as below:

(ii) Chir and Deodar:- The cull in case of Chir and Deodar was negligible (less than 1%) and hence no tables have been prepared.

(iii) Kail:- Following table show the distribution of cull in different diameter classes:-

TABLE NO. IV-5.

CULL FACTORS
Species- Blue- Pine.

Diam. Class in cm.	No. of OBS.	Mean Volume (cu. M) Gross	Net	Cull percentage Calculated	From Graph
10-20	2	.0.065	0.065		
20-30	6	0.447	0.442	1.1	1.1
30-40	19	1.012	0.999	1.3	1.3
40-50	23	2.168	2.115	2.4	1.9
50-60	20	2.832	2.758	2.6	2.6
60-70	10	4.619	4.565	1.2	3.4
70-80	10	5.648	5.363	5.1	3.9
80-90	3	6.923	6.610	4.5	4.5

From the study of this table, maximum cull percentage of 4.5% (as read from graph) is for 80 cm. to 90 cm. diameter class. This is based on small number of observations. In addition some of inaccessible hill forests could not be reached for fellings. It will therefore, be quite safe to allow 5% deduction for blue pine from the total volume on account of cull.

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(iv) Fir and Spruce:- Cull is maximum in case of Fir and Spruce. Some of the inaccessible Fir forests could not be visited for conducting fellings. Some of the Fir forests have not been worked at all. It is worth mentioning that the cull is least in well managed and regularly worked forests on account of their accessibility like Chir and Deodar.

(v) As read from the graph, cull is about 20% for 80 cm. to 90 cm. diameter class, whereas it is about 28% for 90 cm. to 100 cm. diameter class. Keeping in view all these factors, 30% deduction for Fir and Spruce from the total volume on account of cull is considered reasonable.

(vi) Following table shows the distribution of cull by diameter classes:-

TABLE NO. IV-6.

CULL FACTOR

SPECIES- FIR + SPRUCE

Diam. Class (cu.m.)	No. of OBS	Mean Volume (cu. ms.) Gross	Net	Cull Percentage Calculated	From Graph.
10-20	2	0.100	0.100		
20-30	10	0.415	0.413	0.5	0.5
30-40	16	1.109	1.087	2.0	0.7
40-50	8	1.781	1.741	2.2	1.3
50-60	10	2.993	2.838	5.2	2.6
60-70	12	4.927	4.846	1.6	5.8
70-80	13	7.435	6.967	6.3	9.7
80-90	7	8.330	6.672	19.9	19.9
90-100	8	10.924	7.873	27.9	27.9
100-110	4	13.698	12.226	10.8	

8. NET GROWING STOCK:

After deduction of volume on account of cull, the position of gross and net growing stock by different species from all the strata works out approximately as under:-

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TABLE NO. IV- 7.

Species	Volume in '000 cubic metres. Gross	Net (after deduction of cull).
Fir/Spruce	42,690.7	29,883.5
Blue Pine	17,905.5	17,010.2
Deodar	24,474.6	24,474.6
Chir	2,403.5	2,403.5
Ban Oak	1,041.0	1,041.0
Others	13,341.3	13,341.3
TOTAL:	1,01,856.6	88,154.1

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C H A P T E R-V.

MANAGEMENT PRACTICES.

PRESENT AND FUTURE PROPOSALS

PRESENT MANAGEMENT

1. OBJECTIVES:

The objectives of present management practices are summarised as under:-

(i) to preserve and improve forests for soil and water conservation.

(ii) to meet the bonafide domestic and agricultural requirements of the local people for timber fuelwood, fodder and grazing of their cattle.

(iii) to manage the forests according to their silvicultural requirements and site, and

(iv) to obtain maximum sustained yield of timber and sustained income for the Government.

2. In order to cope up with the above objective, the management practices being followed indifferent Forest Divisions are given in the following table.

Sl. No.	Forest Division	Working Circles	Main Species	Silvicultural system	Rotation (Yrs.)	Exploitable diam. (in cm.)	Conversion/ Regenration period or felling cycle (yrs)	Remarks.
1	2	3	4	5	6	7	8	9
1.	Ramban	(i) The Kail Conversion.	Deodar & Kail	Conversion to Uniform under shelter wood system.	150	Deodar(65) Kail (73)	30	

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1	2	3	4	5	6	7	8	9
	(ii) Deodar Kail Selection.	Deodar, Kail and mixed Fir Forests.	Selection System.	180	Deodar (75) Kail (60) Fir (75)	30	Proportion of Deodar & Kail is higher.
	(iii) Fir selection	Fir forests.	-do-	180	Deodar (75) Kail (60) Fir (75)	30	
	(iv) Chir Interim	Chir	Thinning and improvement fellings.	120	Chir (75)	30	Conservative removal of mature and over mature stock only.
	(v) Protection cum improvement.	All conifers	Restricted felling as in the case of Deodar Kail selection working circle; strict Fire protection and closure to grazing.	-	As in the case of Deodar, Kail selection w.c.	-	Situated on rugged and highly precipitous ground
	(vi) High pasture land Development.	Alpine & sub-Alpine pasture land.	Rotational closures.	-	-	-	-
2.	Bhadarwah.	(i) Uniform.	Accessible Deodar Kail Forest with little Fir in nalas higher up.	Conversion to uniform under shelter wood system.	150	Deodar & Kail	80	Exploitation period is 20 years.

* Source:- Working Plan (Ramban) 1961-62 to 1971-72.

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1	2	3	4	5	6	7	8	9
	(ii) Mixed coniferous selection.	Mixed Deodar Kail, Fir Forests.	Selection system.	180	Deodar(75) & Kail Fir (60)		30	Proportion of Deodar & Kail higher than Fir.
	(iii) Fir selection.	Fir Forests	Selection system.	180	Deodar (75) Kail (60) Fir (60)		30	
	(iv) Unregulated.	High level & poor forests on highly precipitious ground.	Restricted fellings.	-	-		-	Strict fire protection & improvement fellings to be done.

* Source:- Bhadarwah Working Plan 1954-55 to 1973-74.

** Conversion period from the commencement of this plans.

3.	Doda	(i) Deodar Uniform.	Accessible Deodar and Kail forests.	Modified shelter wood compartment system.	150	Deodar (67) Kail (60) Fir		90**
		(ii) Mixed coniferous selection.	Deodar, Kail mixed with Fir.	Selection system.	180	Deodar (67) Kail) Fir) (60)		30
		(iii) Fir Uniform	Fir, Kail Deodar	Modified shelter wood system.	180	All species(60)		180
		(iv) Fir Selection	Fir, Kail Deodar	Selection system.	180	Fir (75) Deodar)(60) Kail)		30
		(v) Unregulated.	All Conifers.	Important felling.	-	-	-	Poorly stocked & uncommercial forest Removal of over mature forests only.

* Source:- Doda Working Plan 1958-59 to 1987-88

** Approximately a period of 60 years has already passed.

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1	2	3	4	5	6	7	8	9
4.	Kishtwar	(i) Deodar Kail Selection.	Accessible Deodar Kail Forest & at places mixed with fir.	Indian Selection System.	150 for Deodar & Kail 160 for Fir.	Deodar(75) & Kail Fir (75)	30	
		(ii) Fir selection.	Predominently pure Fir.	Selection System.	180	Fir(75) Kail Deodar	30	
		(iii) Unregulated cum Improvement.	All coniffers inaccessible forests.	Improvement fellings.	-	-	-	

* Source:- Kishtwar Working Plan 1961-62 to 1967-68.

Since the area of Udhampur Forest Division covered by the Survey is very small, information has not been collected for that division.

3. ANALYSIS:

From the perusal of working plans and the above tabulations it is clear that:-

(i) the forests are being managed mainly with a view to produce large sized trees for Railway sleepers. Trees over 60 cms. in diameter are considered to be quite suitable for economic conversion into sleepers and scantlings which are in great demand in the market,

(ii) the accessible Deodar and Kail forests are managed mostly under shelterwood system,

(iii) Fir forests and the inaccessible forests are being managed under Selection system (Except Doda Division) and

(iv) use of these woods is not being made for any industrial purposes.

4. FUTURE PROPOSALS:

Large sized timber for Railway sleepers may continue to be in demand for a long time to come. Some of the forests may, therefore, have to be managed for the

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production of large sized timber.

4. Our country needs newsprint and paper very badly. Coniferous timbers i.e. those of Fir (including Spruce), Kail and Chir are very suitable for the production of high grade pulp which can be used for production of both newsprint and paper after mixing with mechanical pulp produced from other hardwoods and inferior species. Some of these valuable resources may, therefore, need to be managed with a view to setting up of pulp and paper industry to the requirement of the country and thus saving the valuable foreign exchange.

5. For manufacture of pulp and paper, small sized timber (i.e. upto 5 cms. diameter over bark) can be used. Fir, Kail and Chir forests may, therefore, have to be worked on shorter rotations.

6. Besides the environmental aspect of the forests, the concept of economic planning has also to be kept in view. Longer rotations usually mean smaller return on the investments. Shorter rotations for Fir, Kail and Chir may, therefore, have to be adopted to grow the forests for setting up industries.

7. It is, therefore, suggested that the forests be managed with a view to establishing the pulp and paper industry, in addition to the objectives laid for the present management.

8. This would involve, perfection in the regeneration techniques of all the coniferous forests.

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CHAPTER- VI.

RATE OF GROWTH

1. MEAN AGE BY DIAMETER CLASSES:

Felled tree data gave the following distribution of age and by 10 cm. diameter classes in respect of the four coniferous species:-

TABLE NO. VI-I.

MEAN AND S.D. OF AGE DISTRIBUTION BY 10 cm. DIAMETER CLASSES.

SPECIES- FIR

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100±
		84	65	172	113	212	173	252	218	256
		79	193	172	331	201	183	222		
		61	64	194	185	132	205	325		
		122	221	172	213	201	191			
		72	117	86	161	178	172			
		71	172	203	177	158	182			
		66	95	161	120	170				
			106	241		206				
			143							
			75							
			170							
			141							
			184							
			157							
			204							
Total		555	2107	1401	1300	1458	1106	799	218	256
N		7	15	8	7	8	6	3	1	1
Mean		79.3	140.5	175.1	185.7	182.3	184.3	266.3	218.0	256.0
S.D.		20.3	51.4	44.1	73.2	27.9	12.3	53.0	.0	.0

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TABLE NO. VI.-2.

SPECIES- BLUE-PINE

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
	19	61	57	74	71	105	141	102	157
	43	91	72	87	86	84	63	112	
		120	76	81	77	61	132	144	
		85	74	145	109	87	93	159	
		63	65	76	98	103	107		
		83	82	80	76	98	127		
		67	77	138	98	106	111		
			84	75	91	103	182		
			70	83	94	100	124		
			78	73	116	78			
			69	62	81				
			73	73	84				
			58	78	119				
			74	96	73				
			74	70	101				
			68	80	89				
				105	88				
				96	109				
				73	77				
				92	79				
				74					
				74					
				75					
				68					
Total:	62	570	1151	2028	1816	925	1060	517	157
N	2	7	16	24	20	10	9	4	1
Mean	31.0	81.4	71.9	84.5	90.8	92.5	117.8	129.2	15.70
S.D.	17.0	20.6	7.5	20.1	14.4	14.7	32.8	26.7	.0

CONTD.....23

TABLE NO. VI-3.

MEAN AND S.D. OF AGE DISTRIBUTION IN 10 cm. DIAMETER CLASSES.

SPECIES- DECDAR

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
	56	75	54	94	59	93	136	100	207
	52	115	75	126	116	183	156		134
	76	73	84	95	105	99	156		95
	63	81	89	96	129	90	119		93
	80	76	60	107	137	97			184
		90	88	106	116	119			
		75	88	103	87	99			
		71	59	122	102	96			
		95	90	58	120	101			
		75	95	87	141	111			
		89	74	94	87	111			
		70	75	88	104	147			
		114	82	79	100	129			
		95	107	100	96	97			
		92	96	111	97	110			
		73	57	97	97	91			
		92	74	90	99	97			
		71	75	148	100	195			
		73	55	93	94	195			
		67	72	93	88				
		63	69	97					
		69	68	90					
		71		90					
		74		56					
				58					
				82					
				52					
				74					
Total:	327	1969	1686	2586	2074	2260	567	100	713
N	5	24	22	28	20	19	4	1	5
Mean.	65.4	82.0	76.6	92.4	103.7	118.9	141.7	100.0	142.6
S.D.	12.2	17.9	14.5	21.2	18.9	35.1	17.8	.0	51.6

CONTD.....24

TABLE NO. VI-4.

MEAN AND S.D. OF AGE DISTRIBUTION IN 10 cm. DIAMETER CLASSES.

SPECIES- CHIR

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100+
		63	62	65	85	85	97			
		93	63	64	65	76				
			59	69	87	81				
			59	65	77	82				
			77	63	94					
			90	59	99					
			80	72	95					
			87	57						
				92						
				95						
				93						
				87						
				92						
Total:		156	577	975	602	324	97			
N		2	8	13	7	4	1			
Mean.		78.0	72.1	74.8	86.0	81.00	97.0			
S.D.		21.2	12.8	14.5	11.8	3.7	.0			

2. DIAMETER-AGE-HEIGHT RELATIONSHIP:

The distributions mentioned above in tables 1 to 4 between mean age by diameter classes were plotted on a graph. A continuous smooth curve was drawn to show relationship between age and diameter. Corrections were applied for age upto the breast height. Values for age were read from these graphs for specific diameters and for different species. The results are tabulated below;-

CONTD.....25

TABLE NO. VI- 5.

DIAMETER/AGE / HEIGHT

Diameter (cms.)	Species							
	FIR		BLUE PINE		DEODAR		CHIR	
	Age (Years)	Height (M)	Age (Years)	Height (M)	Age (Years)	Height (M)	Age (Years)	Height (M)
10	-	-	-	-	-	-	-	-
20	-	-	52	16	68	17	-	-
30	95	25	66	24	79	25	62	22
40	125	28	78	29	89	30	71	27
50	153	33	89	33	100	33	79	29
60	179	38	100	35	111	35	84	30
70	201	42	111	38	122	37	89	31
80	220	45	124	40	134	38	-	-
90	238	48	136	41	144	39	-	-
100	254	49	-	-	-	-	-	-

3. DISTRIBUTION NO. OF STEMS/HECTARE:

Distribution of number of stems per hectare in each stratum by important species and 10 cm. diameter classes are given in the following tables:-

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TABLE NO. VI-6.

Fir (Forest + Open forest) Distribution of stems per hectare.

Stratum Sl. No.	Species Group	Diameter Classes (cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	TOTAL
1.	Chir	0.00	.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59
2.	Blue Pine	5.26	5.26	4.55	0.56	1.36	0.59	.80	.44	.27	.22	.05	.02	19.40
3.	Deodar	0.00	1.32	1.25	0.00	.20	.47	.44	.32	.25	.20	.12	.14	4.71
4.	Fir/ Spruce.	18.86	69.31	34.91	20.48	13.19	9.21	7.37	7.19	5.34	3.57	1.54	1.89	192.88
5.	Ban Oak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	Others	0.00	24.14	9.08	7.80	4.21	1.70	1.14	.92	.30	.24	.13	0.05	49.71
	STRATUM TOTAL.	24.12	100.62	49.79	28.84	18.96	11.97	9.75	8.87	6.16	4.23	1.84	2.10	267.29

CONTD.....27

TABLE NO. VI-7

STRATUM. BLUE PINE (FOREST + OPEN FOREST) DISTRIBUTION STEMS FOR HECTARE

Sl. No.	Species Group	Diameter Classes (cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	Total.
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue Pine	3.88	19.34	32.76	26.80	20.97	15.70	6.07	2.70	1.19	.75	.20	.20	130.56
3.	Deodar	0.00	10.25	3.24	4.59	1.52	.97	.46	.38	.22	.18	.03	.06	21.90
4.	Fir, Spruce	0.00	2.37	2.06	2.24	1.05	.21	.15	.12	.18	.08	.00	.01	8.47
5.	Ban Oak	0.00	1.60	0.00	0.00	0.00	.11	.07	.11	.00	.00	.03	.00	1.92
6.	Others	0.00	6.64	2.58	1.99	.66	.45	.07	.33	.09	.07	.03	0.00	12.91
	STRATUM TOTAL:	3.88	40.20	40.64	35.62	24.20	17.44	6.82	3.64	1.68	1.08	.29	.27	175.76

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TABLE NO. VI-8.

STRATUM — DEODAR (FOREST + OPEN FOREST) DISTRIBUTION OF NO. OF STEMS PER HECTARE

Sl. No.	Species Group	Diameter Classes (Cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	Total
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue Pine	0.00	8.69	6.81	5.55	3.44	2.62	1.45	.90	.11	.16	.06	.12	29.91
3.	Deodar	80.30	133.73	73.45	41.61	29.44	16.79	9.75	4.93	2.72	1.52	.69	.89	395.62
4.	Fir/ Spruce	0.00	3.89	4.65	1.60	1.29	.95	.39	.19	.10	.08	1.00	.11	13.25
5.	Ban Oak	0.00	1.22	3.07	1.25	.20	.27	.07	0.00	0.00	.04	0.00	0.00	6.12
6.	Others	9.89	2.92	2.68	1.75	.77	.61	.42	.34	.05	.04	.04	0.00	19.51
STRATUM TOTAL:		90.19	150.45	90.66	51.76	35.14	21.24	12.08	6.36	2.98	1.64	.79	1.12	464.41

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TABLE NO. VI- 9.

STRATUM — CHIR (FOREST + OPEN FOREST) DISTRIBUTION OF NO. OF STEMS PER HECTARE

Sl. No.	Species Group	Diameter Classes (Cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	TOTAL
1.	Chir	0.00	25.33	26.83	25.69	14.51	13.28	5.10	3.02	.55	.31	0.00	.34	114.96
2.	Blue Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.	Deodar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.	Fir/ Spruce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.	Ban Oak	0.00	3.71	0.00	0.00	.76	.48	0.00	0.00	0.00	0.00	0.00	0.00	4.95
6.	Others	0.00	7.85	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	8.07
	STRATUM TOTAL:	0.00	36.89	26.83	25.69	15.27	13.76	5.10	3.24	.55	.31	0.00	.34	127.98

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TABLE NO. VI- 10.

STRATUM OTHERS (FOREST + OPEN FOREST) DISTRIBUTION OF NO. OF STEMS PER HECTARE

Sl. No.	Species Group	Diameter Classes (cm) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	TOTAL.
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue Pine	6.75	6.19	2.32	1.72	1.33	.62	.31	.12	.18	.11	.03	0.00	19.68
3.	Deodar	0.00	0.00	1.28	.24	0.00	0.00	.08	.11	.05	0.00	.06	.01	1.83
4.	Fir/ Spruce	13.27	8.91	3.11	1.50	1.33	1.28	.38	.49	.25	.21	.20	.39	31.32
5.	Ban-Oak	13.33	22.46	4.63	2.23	1.09	.52	.26	.18	.05	0.00	0.00	0.00	44.75
6.	Others.	59.85	137.87	58.43	26.78	12.79	6.57	3.77	1.73	.93	.51	.47	0.15	309.85
STRATUM TOTAL:		93.20	175.43	69.77	32.47	16.54	8.99	4.80	2.63	1.46	.83	0.76	0.55	407.43

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4. From the study of these tables it becomes evident that the:-

(i) Distribution of stems of different diameter classes is satisfactory in Fir, Deodar and ' Other ' strata.

(ii) Whereas it is not satisfactory in strata like Blue-pine and Chir where lower diameter classes are rather poorly represented.

5. DISTRIBUTION OF VOLUME PER HECTARE:

Tables VI-11 to VI-15 display the distribution of Volume per hectare by important species by diameter classes (10 cm.) in each stratum.

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TABLE NO. VI-11

STRATUM — FIR (FOREST + OPEN FOREST) DISTRIBUTION OF VOLUME/PER HECTARE m^3

Sl. No.	Species Group	Diameter Classes (cm) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	TOTAL
1.	Chir	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
2.	Blue-Pine	.57	.73	1.57	.39	2.14	1.49	3.17	2.38	1.89	1.94	.39	.41	17.27
3.	Deodar	0.00	.17	.56	0.00	.33	1.40	1.81	1.66	1.70	1.73	1.37	2.62	13.35
4.	Fir/ Spruce	1.33	7.91	13.20	19.66	23.00	26.13	30.58	41.11	40.53	35.27	18.81	34.41	291.94
5.	Ban-Oak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	Others	0.00	1.58	2.13	4.88	4.99	3.19	3.26	3.68	1.54	1.58	1.18	.77	28.78
STRATUM TOTAL:		1.90	10.45	17.46	24.93	30.46	32.21	38.82	48.83	45.66	40.52	21.95	38.21	351.40

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TABLE NO. VI-12.

BLUE PINE (FOREST + OPEN FOREST) DISTRIBUTION OF VOLUME m^3/PER HEC.

STRATUM

Sl.No	Species Group	Diameter Classes (cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	Total.
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue-Pine	.35	2.69	12.32	22.38	33.13	39.97	22.56	14.21	8.44	6.73	2.30	3.02	168.10
3.	Deodar	0.00	1.40	1.40	4.04	2.44	2.58	1.79	2.15	1.56	1.59	.32	.99	20.26
4.	Fir/ Spruce	0.00	.32	.81	1.94	1.64	.60	.63	.66	1.35	.69	1.00	.38	9.02
5.	Ban-Oak	0.00	.10	0.00	0.00	0.00	.20	.22	.45	0.00	0.00	.24	0.00	1.21
6.	Others	0.00	.33	.66	1.34	.74	.81	.22	1.35	.47	.45	.24	0.00	6.64
STRATUM TOTAL:		.35	4.84	15.19	29.70	37.95	44.16	25.42	18.82	11.82	9.49	3.10	4.39	205.23

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TABLE NO. VI-13.

STRATUM — DEODAR (FOREST + OPEN FOREST) DISTRIBUTION OF VOLUME/m^3/PER HECTARE

Sl. No.	Species Group	Diameter Classes (cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	Total
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue-pine	0.00	1.30	2.04	4.82	5.40	6.43	5.58	4.77	.70	1.44	.74	1.90	35.10
3.	Deodar	8.58	21.56	32.97	40.58	50.47	45.61	38.22	26.16	19.00	11.82	7.63	16.08	318.68
4.	Fir/ Spruce.	0.00	.55	1.83	1.36	2.17	2.70	1.80	1.11	.76	.79	0.00	1.62	14.69
5.	Ban Oak	0.00	.12	.74	.73	.20	.45	.25	0.00	0.00	.27	0.00	0.00	2.76
6.	Others	.46	.14	.56	1.12	.03	1.14	1.22	1.29	.24	.27	.27	0.00	7.53
	STRATUM TOTAL:	9.04	23.67	38.14	48.61	59.07	56.33	47.05	33.30	20.72	14.59	8.64	19.60	378.76

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TABLE NO. VI-14.

STRATUM CHIR(FOREST + OPEN FOREST) DISTRIBUTION OF VOLUME/m^3 PER HECTARE.

Sl. No.	Species Group	Diameter Classes (cm.) -10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110 +	Total.
1.	Chir	0.00	1.88	7.70	18.71	19.67	31.76	17.37	14.57	3.80	2.58	0.00	5.47	123.51
2.	Blue Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.	Deodar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.	Fir/ Spruce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.	Ban-Oak	0.00	.47	0.00	0.00	.78	.86	0.00	0.00	0.00	0.00	0.00	0.00	2.11
6.	Others	0.00	.92	0.00	0.00	0.00	0.00	0.00	.97	0.00	0.00	0.00	0.00	1.89
STRATUM TOTAL:		0.00	3.27	7.70	18.71	20.45	32.62	17.37	15.54	3.80	2.58	0.00	5.47	127.51

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TABLE NO. VI-15.

STRATUM — OTHER (FOREST + OPEN FOREST). DISTRIBUTION OF VOLUME/PER HECTARE. (m^3)

Sl. No.	Species Group	Diameter Classes (Cm.)												
		-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110+	Total
1.	Chir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Blue Pine	.67	.75	.78	1.41	2.13	1.41	1.23	.63	1.32	1.02	.35	0.00	11.70
3.	Deodar	0.00	0.00	.49	.27	0.00	0.00	.31	.65	.33	0.00	.68	.36	3.09
4.	Fir/ Spruce.	1.00	1.02	1.04	1.27	2.34	3.45	1.68	2.76	1.77	2.20	2.61	7.72	28.86
5.	Ban-Oak	0.62	1.40	1.47	1.38	1.15	1.09	.67	.71	1.21	0.00	0.00	0.00	8.74
6.	Others	3.04	8.71	14.06	16.38	15.20	12.39	10.92	6.87	4.89	3.52	3.83	2.14	101.95
STRATUM TOTAL:		5.33	11.88	17.84	20.71	20.83	18.34	14.81	11.62	8.55	6.74	7.47	10.22	154.34

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6. From the perusal of these tables it is revealed that:-

(i) In case of Fir stratum, the distribution of Volume for Fir species tends to increase upto 70 to 80 cm. diameter class and then starts decreasing, it is maximum corresponding to a diameter class of 70 to 80 cms.

(ii) In case of Blue Pine stratum, the Volume distribution for Blue Pine species is maximum corresponding to diameter class 50 to 60 cms.

(iii) In Deodar stratum it is maximum at 40 to 50 cm. diameter class for Deodar species.

(iv) In Chir stratum, it is maximum for the diameter class 50 to 60 cms. for Chir species, and

(v) In stratum 'Other' it is maximum for 40 to 50 cms. diameter class for all the species.

7. DISTRIBUTION OF VOLUME PER HECTARE BY DIFFERENT DIAMETER CLASSES AND THEIR CORRESPONDING MEAN AGE:

The distribution of Volume per hectare by different diameter classes and their corresponding age (read from graph against mid point of each diameter class) of Fir, Kail, Deodar and Chir in Fir, Kail, Deodar and Chir strata respectively is tabulated below:-

TABLE NO. VI-16.

DISTRIBUTION OF VOLUME/HECTARE BY DIFFERENT DIAMETER CLASSES AND THEIR CORRESPONDING MEAN AGE IN DIFFERENT STRATA.

Diameter classes in cms.	Fir in Fir Strata		Kail in Kail Strata		Deodar in Deodar Strata		Chir in Chir Strata	
	Volume in m^3	Mean age in years	Volume in m^3	Mean age in years	Volume in m^3	Mean age in years	Volume in m^3	Mean age in years
-10	1.33		.35		8.58	-	0.00	
10-20	7.91		2.69	44	21.56	62	1.88	
20-30	13.20	79	12.38	50	32.97	74	7.70	-
30-40	19.66	110	22.38	72	40.58	84	18.71	67
40-50	23.00	140	33.13	84	50.47	95	19.67	75
50-60	26.13	167	39.97	95	45.61	106	31.73	83
60-70	30.58	191	22.56	106	38.22	117	17.37	87
70-80	41.11	211	14.21	118	26.16	128	14.57	91
80-90	40.53	230	8.44	130	19.00	139	3.80	-
90-100	35.27	246	6.73	142	11.82	150	2.58	-
100-110	18.81	262	2.30	-	7.63	-	0.00	-
110+	34.41	-	3.02	-	16.08	-	5.47	-
TOTAL:	291.94		168.10		318.68		123.51	

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8. AGE OF THE CROP CORRESPONDING TO DIAMETER CLASSES FOR WHICH VOLUME DISTRIBUTION IS MAXIMUM:

The age of the different coniferous species corresponding to their respective diameter class for which the volume is maximum, is summarised as below:-

TABLE NO. VI-17.

Stratum	Species	Diameter class for which Volume is maximum.	Approximate age in years.
Fir	Fir/Spruce	70 to 90 cms.	211
Blue Pine	Kail	50 to 60 cms.	95
Deodar	Deodar	40 to 50 cms.	95
Chir	Chir	50 to 60 cms.	83
Others	Others	40 to 50 cms.	Not known.

9. AVERAGE AGE OF THE CROP:

Average age of Fir, Kail, Deodar and Chir in Fir, Kail, Deodar and Chir strata respectively works out as under:-

TABLE NO. VI-18.

Stratum	Species	Average crop age(Years)
Fir	Fir/Spruce	165.00
Blue Pine	Kail	94.90
Deodar	Deodar	104.00
Chir	Chir	80.30

10. MEAN ANNUAL INCREMENT:

Mean Annual Increment for Fir, Kail, Deodar and Chir in Fir, Kail, Deodar and Chir strata respectively corresponding to mean age of these species

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is approximated as under:-

TABLE NO. VI-19.

Species	Stratum	Mean age in years	Mean annual Increment/hec. (m^3)
Fir/Spruce.	Fir	165.0	1.77
Kail	Blue Pine	94.8	1.77
Deodar	Deodar	104.0	3.01
Chir	Chir	80.3	1.54

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CHAPTER VII.

POTENTIAL ANNUAL CUT

1. GENERAL:

Potential Annual Cut is a function of growing stock, rotation, rate of growth, management practices and several other important factors.

2. GROWING STOCK-GROSS AND NET:

Forest areas by different forest strata and the growing stock therein, are given in Table No. 3 in Chapter III. In the Chapter IV total growing stock by Forest Strata and by important species is given in Table No. IV-4 whereas the net growing stock by important species, after deduction of volume due to cull factors, is given in Table No. IV-7 and is reproduced as under:-

TABLE NO. VII-I

Forest Species	Volume in '000' Cubic meters	
	Gross	Net
Chir	2,403.5	2,403.5
Blue pine	17,905.5	17,010.2
Deodar	24,474.6	24,474.6
Fir & Spruce	42,690.7	29,883.5
Ban-Oak	1,041.0	1,041.0
Others	13,341.3	13,341.3
TOTAL:	1,01,856.6	88,154.1

3. RATE OF GROWTH:

As already calculated and described under Chapter VI on ' Rate of Growth' Mean Annual Increment of Fir (including Spruce) Kail, Deodar and Chir in Fir Kail, Deodar and Chir strata respectively corresponding to the mean age of these species worked out (Table No. VI-19) is as under:-

TABLE NO. VII-2.

Species	Stratum	Mean age (Years)	M.A.I/hectare(m^3)
Chir	Chir	80.3	1.54
Kail	Blue pine	94.8	1.77
Deodar	Deodar	104.0	3.01
Fir/Spruce	Fir	165.0	1.77

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4. From the volume tables and age diameter relationships periodic Annual Increment percent at different diameters and corresponding to different ages are tabulated as below:-

TABLE NO. VII-3.

PERIODIC ANNUAL INCREMENT PERCENT

Diameter in cms.	Fir/Spruce		Kail		Deodar		Chir	
	Age	P.A.I %	Age	P.A.I%	Age	P.A.I%	Age	P.A.I%
5	-	-	23	1.86	40	3.75	-	-
15	-	-	44	7.89	62	8.89	13	8.39
25	70	2.80	59	6.91	74	7.89	39	4.35
35	110	2.09	72	5.44	84	5.44	59	4.47
45	140	1.86	84	4.71	95	4.23	74	3.99
55	167	1.62	95	3.51	106	3.51	87	3.04
65	191	1.64	106	2.80	117	2.80	100	2.57
75	211	1.39	118	2.57	128	2.57	113	2.33
85	230	1.53	130	2.09	139	2.23	125	3.04
95	246	1.39	142	1.62	150	2.09	-	-
105	262	1.64	156	1.16	160	1.62	-	-
115	274	-	171	-	172	-	-	-

5. From the study of the above table, it is evident that trend of P.A.I% at lower ages as well as at the higher ages is not satisfactory(probably on account of scanty data in these classes). The results may, therefore, be used with utmost caution at these stages.

6. ROTATION:

In Chapter V on Management Practices (para 3) it has been anticipated that some of the coniferous forests shall continue to be managed to

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produce large sized timber, mainly for railway sleepers. Trees over 60 cms. in diameter (at B.H. and O.B.) are quite suitable for economic conversion into sleepers and scantlings.

7. Approximate age for production of this large sized timber in different conifers along with proposed rotations is as follows:-

TABLE NO. VII-4.

Species	App. age for production of Big sized timber(in Years)	Proposed rotations in years.
Chir	84	100
Blue Pine	100	120
Deodar	110	120
Fir/Spruce	180	180

8. The need to produce wood for the setting up of pulp and paper industry, requires to change the management, at least in some of the areas. Fir (including spruce). Blue Pine and Chir woods are very suitable raw materials for paper and pulp industries. Deodar of course, is a very good timber species and, therefore, will not be available for pulp in appreciable quantities.

9. Trees of the size 30 cms. diameter (at B.H. and O.B.) are considered suitable for the pulp and paper industry. Apple orchards coming up in this area will also require wood for preparation of wooden packing cases. Trees with diameters of 40 cms.(at B.H. and O.B.) have been considered quite suitable for making of apple packing cases as well as for production of pulpwood. The age of different coniferous species to obtain 40 cms. diameter along with possible rotation is as under:-

TABLE NO. VII-5.

Species	Age to obtain 40 cms. DBH(Years)	Possible rotation(Years)
Chir	71	70
Kail	78	80
Deodar	120	120
Fir/Spruce	125	125

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10. MANAGEMENT PRACTICES:

Nothing rigid can be suggested in so far as the Silvicultural Systems are concerned for the future management of the individual species. The subject has already been discussed in Chapter V. The Silvicultural System to be adopted for the management of a particular species will depend upon a variety of factors like the objectives for which the species is being managed. The state of development of regeneration techniques and many other factors like closure to grazing etc.

11. Silvicultural system to be followed may, therefore, vary from Selection to Shelter-wood and even clear felling in some of the areas when the technique of artificial regeneration is perfected. This is, however, a subject which can best be left to the State Forest Department.

12. INDUSTRIAL WOODS:

Coniferous woods namely Fir/Spruce, Kail and Chir provide a valuable long fibred raw material for the production of pulp and paper. Kail and Chir trees, however, exude resin from which rosin and turpentine oil are produced and are put to a number of industrial uses.

13. Deodar is a good timber used mainly for constructional purposes. Deodar oil produced from the distillation of deodar wood chips forms an excellent base for perfumes.

14. Broad leaved species are used for various purposes. Walnut and Maple are good for manufacture of shuttle and bobbin blocks for textile industry. Kharsu and Betula are also used for bobbin blocks. Ban and Mohru oaks are good as fuelwood. The broad leaved species are used in furniture industry, for manufacture of wooden packing cases and in a number of small scale industries and have, so far, not been considered as industrial wood of any consequence in the area.

15. OTHER CONDITIONS GOVERNING THE CUT:

The areas taken up for pulpwood felling will have to be regenerated shortly thereafter for which the forest Department of Jammu and Kashmir will have to make sufficient provision of funds.

16. The forest areas to be regenerated have to be closed to grazing for the regeneration period.

17. The cutting models suggested for the area will meet with the requirements of timber and fuelwood of the local population.

18. CUTTING MODELS:

Two models are considered. The requirements for these models are:-

Model I:- aim at the production of large sized trees, 60 cm. dia.(at BH. OB and above) so as to meet with the requirements of Railway Sleepers.

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Model II:- aim at to produce industrial raw material for pulp and paper and wooden packing cases, 40 cms. diameter trees (at B.H. and O.B.) are considered quite suitable for meeting with these requirements.

19. SPECIFICATION FOR THE MODELS:

The detailed specifications with regard to rotation and exploitable diameter for different coniferous species and in respect of the two models is, therefore, summarised below:-

TABLE NO. VII-6.

Species	MODEL: I		MODEL: II	
	Rotation (Years)	Exploitable diameter (Cms.)	Rotation (Years)	Exploitable diameter (Cms)
Chir	100	60	70	40
Blue Pine	120	60	80	40
Deodar	120	60	120	60
Fir/ Spruce.	180	60	125	40

20. ANNUAL YIELD:

Annual yield for the coniferous species (Fir/Spruce, Blue Pine, Deodar and Chir) will be regulated by the following formula in both the Models.

$$\text{Annual yield} = \frac{\text{Total Growing stock (net)}}{\text{Rotation}} + \frac{1}{2} \times \text{Rotation} \times \frac{\text{MAI of the stratum}}{\text{Rotation.}}$$

21. Annual Cut for the conifers under both the Models, will therefore, be as follows:-

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TABLE NO. VII-7.

Species	Annual Cut (m^3)	
	Model I	Model-II.
Chir	39,000	49,300
Blue Pine	2,07,000	2,78,000
Deodar	3,03,000	3,03,000
Fir/Spruce	2,83,200	3,56,300

22. Annual Cut for the broadleaved species has not been calculated (cf Chapter VII). Broad leaved species may, however, continue to be managed as per current management practices to meet with the requirements of the local population, and cottage industries.

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CHAPTER - VIII

M A R K E T A N D D E M A N D S T U D I E S

1. INTRODUCTORY

The Valley with a population of 3,41,858 consumes only a small quantity of timber produced. The main drain is in the form of fuelwood for which there is no proper record. The timber produced is exported out of the Valley in the form of railway sleepers, scantlings and logs to Jammu and Pathankot for supply to Railways, D.G.S & D., and consumption in the plains of Northern Indian.

2. THE OBJECTIVES

1) To prepare an account of the present (1970-71) production and pattern of wood consumption in the Valley.

2) To forecast the level and trends of wood consumption in the year 1981 and 1991 for the Valley.

W O O D P R O D U C T I O N

3. The production of wood has been obtained from Annual Administrative Reports of the Forest Department of Jammu and Kashmir for the year 1968-69 to 1970-71. The figures of these reports were for sawn wood from Government forests alone. These annual figures for three years have been averaged & converted into Wood Round Equivalents (WRE) so that the total wood production from the forests is estimated. For WRE same conversion factors as for Kashmir Valley Report have been used. For the wood production from Revenue land and private lands, records of the Tehsil offices and the permits issued by the Divisional Forest Offices were consulted.

4. Species-wise information for Deodar (Cedrus deodara), Kail (Pinus Wallichiana), Fir and Spruce (Abies pindrow and Picea Smithiana), Chir (Pinus roxburghii) and mixed conifers was available. Information for Fir and Spruce was not available separately. It was not possible to find out the species wise break up for broad leaved species. Most common broad leaved species is Ban Oak (Quercus incana). Other species of Oaks and other broad leaved species are also included under braod leaved species.

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5. The wood production from different categories of forests by extraction & by various agencies in the Valley is shown in the following table

AREA OF PRODUCTION	AGENCY	FORM
A. Government Forests	(i) Forest lesses.	Railway sleepers · Scantlings round or logs.
	(ii) Forest Department.	
	(iii) Rightholders & concessionists.	As required for house construction, repairs, agricultural implements and fuelwood.
B. Revenue lands	(i) Contractors	As under 'A' for forest lessees
C. Private lands	(i) Contractors	
	(ii) individuals	As needed.

6. PRODUCTION OF WOOD BY LESSEES FROM GOVERNMENT FORESTS :

Forest Lesses are the largest agency extracting the wood from the Government Forests under the control of the Forest Department. The forests are handed over, for extraction of marked trees, to the highest bidder for consideration of royalty to be paid by him under an agreement. Division wise average annual extraction is given in Table NO. VIII 1.

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Table No. VIII - 1.

T I M B E R P R O D U C T I O N B Y L E S S E E

(Average for the years 1968-69 to 1970-71)

(WRE cubic metres)

Division	Deodar	Kail	Fir/ Spruce	Chir	Mixed Coni-fers	Broad leave	Other	Total
Bhadarwah	17229.34	10963.17	27004.54	750.82	-	-	-	55947.87
Ramban	3798.51	1715.80	12292.40	1412.94	13805.05	8041.48	-	41056.18
Kishtwar	21461.05	13345.54	15254.08	-	-	-	-	50060.67
Doda	23862.68	27488.28	37653.42	-	-	-	-	89004.38
Total*	66351.58	53512.79	92204.44	2163.76	13805.05	8011.48	-	236049.10
*Includes firewood (recorded)	2026.00	1520.00	9960.00	207.00	-	8011.48	-	21724.48

7. PRODUCTION OF WOOD BY DEPARTMENTAL AGENCY :

The departmental extraction of wood (1970-71) is done in the area for departmental construction and repairs works. Table No. VIII-2 shows the species wise and division wise details of production.

TABLE NO. VIII-2

Production of wood through Departmental Working

Division	Deodar	Kail	Fir/ Spruce	Chir	Mixed conifers	WRE (cubic metres) Broad leave	Other	Total
Bhadarwah	-	-	No data	-	-	-	-	-
Ramban	70.98	26.26	394.45	-	-	-	-	491.69
Kishtwar	491.37	429.57	-	-	-	-	-	920.94
Doda	18.25	15.97	1.69	-	-	-	-	35.91
Total	580.60	471.80	396.14	-	-	-	-	1448.54

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8. PRODUCTION OF WOOD THROUGH RIGHT HOLDERS AND CONCESSIONISTS :

The population, depends on forests for timber for house construction, agricultural implements, and firewood. Collection of drywood for fuel is allowed free of charge and no record is maintained. There is a limit to the quantity of timber which can be granted to right holders and concessionists at concessional rates. Record is maintained showing the timber given for the right holders and to the concessionists. However timber, in excess of this limit, is required to be purchased at full rates and that quantity is not accounted here, but under sales. (Production by lessees).

Table No. VIII - 3 gives the division and species wise figures for the timber granted to right holders and concessionists.

Table NO. VIII - 3

Production Through Right Holders and Concessionists

Division	WRE (cubic metres)							
	Deodar	Kail	Spruce/ Fir	Chir	Mixed conifers	Broad leaved	Other	Total
Bhadarwah	22.85	964.88	7.31	2.37	-	-	-	997.41
Ramban	71.48	1288.54	1159.74	171.28	-	9.71	-	2700.75
Kishtwar	10.91	3385.48	636.54	-	-	-	121.85	4154.78
Doda	-	-	-	-	1434.31	-	-	1434.31
Total	105.24	5638.90	1803.59	173.65	1434.31	9.71	121.85	9287.25

NOTES :

i) In case of Doda Division the entire quantity is shown under mixed conifers, because records available did not show the break up by species. This quantity is made up of Deodar, Kail and Fir.

ii) The broad leaved species have generally been given for meeting the fuel requirements of local population.

iii) Although Deodar is in maximum demand yet it is given to the right holders and concessionists very sparingly to prevent its resale, due to high prices.

iv) The Kail alone makes 67% of the total timber given to concessionist and right holders because in absence of Deodar, it is the next suitable species as construction timber

v) Chir is not perferred as construction timber.

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9. PRODUCTION OF WOOD FROM REVENUE LANDS :

Large number of trees standing on revenue lands are not exploited on any systematic basis. Felling is occassionally carried out to meet local requirement, but record is not properly maintained. A great effort was made to collect the data for the quantity of wood extracted from this source. Only figures of 1970-71 year were traceable. On the basis of available records the wood extracted through this agency is 69.45 m^3 out of which 26.25 m^3 (Cubic metres) is deodar, 22.88 m^3 is of Kail and 20.00 m^3 broad-leaved. The division wise figures are given in table No. VIII -4.

TABLE NO. VIII - 4

Division	WRB (cubic metres)							
	Deodar	Kail	Fir/ Spruce	Chir	Mixed conifers	Broad leaved	Other	Total
Bhadarwah	4.40	8.63	-	-	-	-	-	13.03
Ramban	-	-	-	-	-	20.00	-	20.00
Kishtwar	19.94	-	-	-	-	-	-	19.94
Doda	2.23	14.25	-	-	-	-	-	16.48
Total	26.57	22.88	-	-	-	20.00	-	69.45

10. PRODUCTION OF WOOD FROM PRIVATE LANDS :

The trees removed from the lands which are neither Govt. forests lands nor Revenue lands have been considered under this. The local population removes a considerable quantity of timber and fuel wood from the trees growing on these lands. Generally, whenever, trees are to be cut from private lands permission from the Deputy Commissioner is required.

11. For the transport of the material transit permits are issued by the Forest Department. Therefore the records at the Tehsil H.Q. at Doda, Kishtwar, Bhadarwah and Ramban and also the records of these Forest Divisions were consulted to obtain the production of wood from private lands. The average annual production comes to 4012.88 m^3 which is about 1.5 percent of the total wood production in the area. The Division and species wise production is given in Table NO. VIII-5.

Table NO. VIII - 5

Production of Wood from Private Land

Division	Deodar	Kail	Fir/ Spruce	Chir	Mixed Conifers	Broad leaves	Other	Total
Bhadarwah	2279.25	89.51	-	-	-	-	-	2368.76
Ramban	532.57	472.91	20.60	47.40	-	213.71	-	1287.19
Kishtwar	145.45	30.37	-	-	-	-	-	175.82
Doda	73.57	107.54	-	-	-	-	-	181.11
Total	3030.84	700.33	20.60	47.40	-	213.71	-	4012.88

12. TOTAL PRODUCTION :

The total production of the wood in the Valley is 2,50,867.26 cubic meters (WRE). The details of production species wise, source & agencies wise is given in Table NO. VIII - 6.

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TABLE NO. VIII-6

AVERAGE ANNUAL WOOD PRODUCTION IN THE VALLEY

	Deodar	Kail	Fir/Spruce	Chir	Mixed conifers	Broad leaved	Others	Total
I. TIMBER & FIREWOOD								
A. GOVERNMENT FORESTS								
i) Forest lessees	56,351.60	53,512.80	92,204.44	2,163.76	13,705.05	8,011.48	-	2,36,049.13
ii) Departmental Extraction.	580.60	471.80	396.14	-	-	-	-	1,448.54
iii) Right-holders & Concessionist.	105.25	5,638.90	1,803.59	173.65	1,343.31	9.71	121.85	9,287.26
Total (A)	67,037.45	59,623.50	94,404,17	2,337.41	15,239.36	8,021.19	121.85	2,46,784.93
B. REVENUE LANDS :	26.57	22.88	-	-	-	20.00	-	69.45
C. PRIVATE LANDS :	3,030.84	700.33	20.60	47.40	-	213.71		4,012.88
Total (B + C)	3,057.41	723.21	20.60	47.40	-	233.71	-	4,082.33
Grand Total (I)	70,094.86	60,346.71	94,424.77	2,384.81	15,139.36	8,254.90	121.85	2,50,867.26
II. FIRE WOOD(Recorded) (Table No.VIII-1)	2026	1520	9920	207	-	8011	-	21,724.48
Total Timber (I - II)	69,068.86	58,826.71	84,464.77	2,177.81	15,239.36	243.42	121.85	2,29,142.78

W O O D C O N S U M P T I O N

13. CONSUMERS OF WOOD

The following categories of wood consumers have been recognised for the purpose of this study :

1) Local population

   (a) for house construction and repairs
   (b) for agricultural implements and
   (c) for fuel.

2) Industries (local)C

3) Government Departments (within the area) (outside the area).

4) Railways, D.G.S. & D.

CONSUMPTION OF WOOD BY LOCAL POPULATION

14. HOUSE CONSTRUCTION :

Winter is generally severe and, in areas above 2000 metres snow fall is quite frequent. 94%of the total population of the area is rural, living in remote villages. The main construction material for the houses is wood. Wood is used, not only to make doors and windows but it is also used for flooring, roofing and even the walls are made of wooden sleepers. Stone is also used to a small extent in these buildings. The local people enjoy the right and concession in the forests and only a nominal price is paid by them for the timber used. As the forests are generally within an easy reach of habitation wood is used extravagantly. No machine sawing facility is available in the villages. Hand sawing is generally done. Rough dressing of logs with axe is also common. This results in tremendous wastage of timber both in felling and conversion.

To evaluate the quantity of timber consumed for the construction of houses in the area 21 representative houses were visited and the quantity of timber used in their construction was calculated by actual measurement. On an average 18.5 cubic meters of timber is used for the construction of an average house. Urban population is only 6% therefore it was not considered necessary to work out the rural and urban requirement of timber for construction of houses separately.

15. From the study of the increase in population from 1961 to 1971 corresponding increase in the number of houses has been calculated. The table NO. VIII - 7 shows the population and number of houses in the Zone in 1961 and projected for 1971

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Table No. VIII -7

Showing Population and number of houses in the Zone.

	Year 1961		Year 1971	
	Population	No. of Houses	Population	No. of Houses
Total	2 68 403	44 015	3 41 858	55 930
Rural	2 52 913	41 215	3 22 229	52 511
Urban	15 490	2 800	19 629	3 419

Source (i) 1961 figures have been obtained from the 1961 Census Report.

(ii) 1971 population figures have been obtained from provisional population table J & K - Paper 1 of 1971.

16. From the above table we see that between the year 1961 & 1971 the population has increased by 75455 persons and the corresponding increase in the number of houses is 11,915 Nos. Assuming that this growth is uniform over the decade the number of new houses that are being constructed annually is 1191. The quantity of timber consumed for this purpose is therefore, 22033.50 m^3 annually.

17. REPAIRS OF HOUSES

Apart from the new constructions a considerable quantity of wood is used for the reparis of old buildings. The damage to old buildings is caused by rain, snow and insect attack. Moreover, the wood itself depending on species, has a limited life. Information gathered from the local inhabitants reveal that repairs are generally required after 15 years cycle. It is generally the timber used on the roof that decays and needs replacement frequently. about 10% of the quantity of timber required for actual construction i.e. 1.83 m^3 is required for each house annually.

18. Therefore, the total annual consumption of timber for house construction and repairs in the area is given here under :-

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Table No. VIII - 8

Requirements of timber for House construction and repairs.

Sl.NO.	Item	No. of Houses Constructed annually.	Quantity of timber required for each house m^3	WRE (cubic meters) Total consumption
1.	New Construction	1 191	18.5	22 033.50
2.	Repairs	1 191	1.85	2 203.35
	Total			24 236.85

19. The timber used for house construction and repairs is mostly coniferous. Deodar is the main species used but when enough deodar timber is not available, Kail is used. Thus out of the total quantity of 24236.85 m^3 the proportion of Deodar and Kail may be considered as 80% and 20% respectively. Therefore, the calculated annual requirement of Deodar & Kail works out to 19389.48 and 4847.37 cubic metres respectively for construction and repairs of houses.

20. WOOD CONSUMPTION FOR AGRICULTURAL IMPLEMENTS :

No systematic survey was conducted to find out the quantity of timber used for the purpose of agricultural implements such as ploughs, Yoke, levellers etc. More than 85% of the population of the Zone is engaged in cultivation. The size of their holdings determines the number of ploughs and other agricultural implements. It is assumed that 2 ploughs for a holding of 5 acres and below, 4 ploughs for holdings of 5-10 acres and 6 ploughs for holdings more than 10 acres are required annually. The total No. of ploughs thus calculated for the Zone is given in table NO. VIII - 9.

Table NO. VIII - 9

Annual requirements of ploughs in the Zone

Size of holding	Number	Number of ploughs.
Less than 5 acres	29, 537	59,074
5 acre to 10 acres	11,815	47,260
More than 10 acres	5,907	35,442
Total	47,259	1,41,776

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Though few parts of ploughs such as Yoke and Beam last longer than 4 years but other parts like shear and shear head seldom last more than one season. Therefore an average life/a plough has been assumed as 3 years. / of

21. The other important implement is leveller. It is assumed that one leveller is sufficient to meet the requirements of three house holds and its life is 6 years. The requirements of timber for a plough and a leveller is estimated to be 0.14 m^3 each. The consumption for this purpose is calculated for the year 1970 which is as follows :

Table No. VIII - 10

Wood Consumed for Agricultural implements

	No.	Quantity of wood consumed in m^3 (r)
Plough	47,259	6,616,26
Levellers	2,452	367.80
Total		6,984.06

22. The species required for agricultural implements are Oaks, Mulberry, Ash and salix etc.

23. FUEL WOOD CONSUMPTION :

Most of the area is without electricity and even coal is not available. Therefore, fire wood remains the only source of heating the house holds. Fuel wood is not only used for cooling purposes but it is also burnt to keep the rooms warm through-out the day and night during the winter months. Even in urban areas fuel wood is the only source of heat and warmth.

24. The sample survey conducted in the area during August/September months revealed that per head consumption of fuel wood for domestic use per day is 1.5 kg. of coniferous fuel and 1 kg. of broad leaved fuel. The requirement during the winter months is 2 to 3 times of this quantity. Thus on an average per capita per day consumption of fuelwood has been considered as under :-

Coniferous wood - 3 Kg.

Broad leaved - 1.5 Kg.

25. On this basis the per capita annual consumption of firewood comes to 1.095 tonnes of coniferous wood and 0.547 tonnes of broad leaved wood.

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26. As per the 1971 census there are 3,41,858 persons living in the area. Therefore, on the above calculations the annual consumption of fuel wood in the zone comes to :-

Coniferous wood	-	3,74,335 tonnes or 8,42,255 m^3 (1 tonne = 2.25 m^3)
Broad leaved	-	1,86,996 tonnes or 2,80,494 m^3 (1 tonne = 1.5 m^3)
Total	-	5,61,331 tonnes 11,22,747 m^3

27. The figures of consumption of fuel wood has not been calculated separately for rural and urban areas because urban population is only 6% of the total population.

28. The main supply of fuel wood is obtained from the forests and trees on private holdings as lops and tops by the concessionists, and right holders. No record for such removal of firewood from the forests is available. Therefore the calculated quantity of firewood consumed is not considered for working out the wood balances.

29. Record for trees granted for firewood or firewood removed from forests under permits is available. The following recorded quantity of firewood may be deducted from the total wood production for working out the wood balances:

Species	Quantity (m^3)
Deodar	2026
Kail	1520
Fir/spruce	9960
Chir	207
Broad leaved	8011
Total	21, 724

30. CONSUMPTION OF WOOD BY SAW MILLS

The saw milling as an industry is still in its infancy in the area. The wood consumed by the saw mills annually is 5123.88 cubic metre. The saw mills

Contents

are located mainly on road sides, in towns and big villages where there is enough demand for sawn wood. In 1970-71 there were only 20 saw mills in the area. The saw mills are primarily engaged in sawing coniferous timber for constructional purpose and to some extent for packing cases to meet the local demand as it arises. Broad leaved species to a very limited extent, are also sawn. The important species sawn are Deodar, Kail , Fir, Chir , Salix species and Poplars. The timber for sawing comes both from gover ment forests and other areas.

31. On the basis of per day in-take of wood and the number of days the saw mills work in a year effort has been made to arrive at a total consumption figure by this industry. Saw mills do not keep an account of daily sawing done, the data is based on the information obtained from the individual owners as per their assessment and thus the figures are approximate. The species wise consumption of wood and the source of wood is given below :-

Table NO. VIII - 11

Annual intake of wood by saw Mills.

VRE . (cubic metre)

Source of wood	Deodar	Kail	Fir	Chir	Broad leaved	Total
From Govt. forests.	964.31	2256.02	710.17	147.25	51.42	4129.17
Out side the Govt. forests	276.02	294.80	-	64.69	359.37	994.88
Total	1240.33	2550.82	710.17	211.94	410.79	5124.05

32. It will be seen from the above table that almost 20% of the total intake of the saw mills comes from the areas outside the Government forests, and about 90% of the broad leaved timber comes from outside the Government forests.

33. The sawn material generally finds its ultimate disposal in the following forms :

i) In house construction and repairs.

ii) In packing case industry.

iii) In furniture industry.

iv) Other small industries.

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34. No separate data is available regarding the quantity of sawn wood consumed for house construction & repair. It is assumed that about 10% of the total sawn material is consumed for house construction and repairs and the balance 90% timber is used in other industries.

35. On the above assumption the timber consumed in local industries works out as under :-

Table No. VIII - 12

Showing timber consumed by Industries

	WRE (cubic metres)					
Total timber	Deodar	Kail	Fir	Chir	Broad leaved	Total
sawn at saw mills.	1240.33	2550.82	710.17	211.93	410.79	5124.04
Sawn timber required for House construc-tions and repairs (10%)	124.03	255.08	71.01	21.18	41.07	512.37
Timber used in industries	1116.30	2295.74	639.16	190.75	369.72	4611.67

36. SUPPLY TO OTHER DEPARTMENTS

A survey was conducted to obtain the annual requirement of Government departments of the area. In all about 239.55 cubic metres of timber is consumed by departments other than forests. The consumption figures by those departments are shown in detail in Table No. 13.

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Table NO. VIII-13

Supply of timber to other Departments.

(cubic metres)

Name of the department	Quantity of timber supplied Deodar	Kail	Fir & Spruce	Chir	Mixed Conifers	Total
P.W.D.	34	3.88	-	-	-	37.88
Soil Conservation Division.	17.57	-	-	-	-	17.57
Copp. Deptt.	3.22	3.25	-	-	-	6.47
Executive Engineer, B & R Udhampur	11.00	-	-	-	5.62	16.62
Executive Engineers, Batote.	4.60	14.82	-	10.17	-	29.59
Sawalkot Investigation Deptt. Ramban	-	-	-	2.34	-	2.34
Gref, Batote	1.91	-	-	-	-	1.91
Dy. Director, Woman Education Banihal.	-	-	-	-	5.71	5.71
Executive Engineer C.W.P.C.	-	-	-	15.42	-	15.42
Other Deptts. including forests	69.22	29.80	7.02	-	-	106.04
Total	141.52	51.75	7.02	27.93	11.33	239.55

37. SUPPLY OF TIMBER TO RAILWAYS AND D.G.S. & D

The area supplies on an average 9871.68 m^3 of conifer timber to the Railway and D.G.S. &D. The year and species wise supply from 1955-56 to 1971-72 is given in the Table 14.

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Table No.VIII. 14

Showing Timber supplied to Railways & D.G.S. & D from the Zone.

Year	Deodar	Kail	Chir	Fir	Total
			WRE (cubic metres)		
1965-66	1,940.28	297.20	475.08	3,613.22	6,325.78
1966-67	2,700.21	829.91	1,771.00	8,331.37	13,632.49
1967-68	2,012.22	292.11	1,464.62	4,589.80	8,358.75
1968-69			figures not available		
1969-70	6,902.00	105.97	564.71	6,231.20	13,803.88
1970-71	2,401.61	10.08	346.94	4,478.80	7,237.43
Total	15,956.32	1,535.27	4,622.35	27,244.39	49,358.33
Average per year	3,191.26	307.05	924.48	5,448.87	9,871.66

Source :- Conservator of Forests
Timber Utilization,
Jammu.

38. A summary of average/annual Consumption of timber and Fuel is given in the following table :-

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Table No. VIII -15

Average Annual Consumption of Timber & Fuel

S.NO.	Utility Class	WRS (cubic meters) Deodar	Kail	Fir/ Spruce	Chir	B.L.	Total
1.	Construction & repair of houses.	19,389.48	4,847.37	-	-	-	24,236.85
2.	Agricultural implements.	-	-	-	-	6,984.06	6,984.06
3.	Fuel (recorded)	2,026.00	1,520.00	9,960.00	207.00	8,011.00	21,724.00
4.	Industry	1,116.33	2,295.74	639.17	190.75	369.72	4,611.71
5.	Other Departments.	141.52	51.75	18.35	27.95	-	239.55
6.	Railway & D.G.S. & D.	3,191.28	307.05	5,448.85	924.48	-	9,871.66
Total		25,864.61	9,021.91	16,066.37	1350.16	15,364.78	67,667.83

FORECAST OF FUTURE DEMAND

39. The future demand of wood is governed by various factors and their inter action. The factors are the population growth, income structure, literacy, price trend of the timber, changes in technology and consumers preferences etc. An analysis and assessment of these factors gives an indication of future demand of timber. The various techniques available, for fore-casts may suffer from one defect or the other.

40. The effect of population on consumption is generally assumed to be uniform.

41. Increase in income and qualitative consumption of wood products is directly related through out the world. Hi$her the per capita income, higher will be the consumption of sawn & quality wood, at least up to a level where the impact of substitute is strongly felt. The elasticity Co-efficient for income can be derived from the formula :-

$$\text{Elasticity co-efficient} = \frac{\% \text{ change in quantity demaned (consumed)}}{\% \text{ change in income.}}$$

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The values to be adopted in this formula can be obtained only if a cross-sectional series of quantities consumed and per capita incomes are available.

42. Price is another important variable. Any realistic forecast has to take into consideration level of price for which the forecast is tenable. This relation-ship is called price Elasticity of Demand.

43. The other demand shifting factors are the change in technology and consumer preferences and are valued only subjectively.

44. A task Force, operating under the aegis of the National Commission on Agriculture, has projected the demand for forest products as follows :-

Table No. VIII-16

PROJECTION OF INDIA'S INDUSTRIAL WOOD REQUIREMENT 1980-90

(Thousand m^3 per annum)

	1980			1990		
	Conifers	Hard woods	Total	Conifers	Hard wood	Total
Pulp wood	1555	3478	5037	4461	8271	12737
Sawn wood & sleeper.	1816	10836	12652	2395	14605	17010
Round wood	1385	5541	6927	1887	7549	9436
Panels	189	755	944	281	1126	1407
Total Industrial wood.	4945	20611	25556	9024	31551	40575

Source :- National Commission on Agriculture Interim report on Production Forestry, Ministry of Agriculture - 1972.

45. Consumption of total industrial wood in the country for the year 1970 has been assessed to be 13,183,000 M^3 (round).

46. A forecast of demand of wood for the year 1981 and 1991 for the area, have been attempted on the basis of data available for the various factors, as analysed.

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47. POPULATION ESTIMATES :

The population of the Zone, according to 1971 census is 341858 and the population for the year 1981 and 1991 has been worked out on the basis of formula in the 'Census of India' as below :

Population in 1971	341858
Population in 1981	435416
Population in 1991	554688

48. INCOME ESTIMATES :

From the available figures of per capita income (Sources Directorate of Economic & Statics J & K) at 1955-56 price the (fixed price) average growth of income per annum between 1960-61 and 1968-69 is 2.04 %. In view of the developmental activities under 4th and fifth plan it is estimate that per capita income will grow to at least 3% upto 1980 and 4.5% between 1980 & 1990. On these basis the average per capita income is expected to be as follows :

Per Capita Income in 1971	Rs.312.80
Per Capita Income in 1981	Rs.400.50
Per Capita Income in 1991	Rs.585.00

49. FORECAST FOR INDUSTRIAL WOOD CONSUMPTION :

The consumption of wood in round by industries is negligible. Packing Cases, Pencil making, Furniture manufacture etc. are consuming most of the sawn material. Therefore the consumption by these industries has been assumed to be the same as the total production from the saw mills.

50. The improvement in per capita income will effect positively the use of sawn wood. As no historical series of consumption figures are available, it is not possible to make out separate income elasticity co-efficient specially applicable to the area. It is proposed to adopt an Income Elasticity of 0.8, the factor arrived at by F.A.O. for India (vide indicative World Plan).

51. For calculation of demand of industrial wood for the target years the formula used by F.A.O. for India is given below ;-

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$\text{Log } \frac{Y^1}{Y} = 0.4343 \times \text{I.E.} \left(1 - \frac{x}{x^1}\right)$

Where Y^1 = per capita consumption at target date.

Y = per capita consumption at starting point

I.E. = Income Elasticity

X = per Capita Income at starting point

X^1 = per Capita Income at target date.

52. The total consumption by species is calculated on the basis of population and income projections for the year 1981 and 1991 and is given as under :-

Table No. VIII-17

Consumption of Timber by Industries forecastfor 1981 and 1991

Year	WRE (cubic metres)					
	Chir	Kail	Deodar	Fir/ Spruce	Broad leaved	Total
1970	191	2295	1116	640	370	4612
1981	291	3469	1689	975	558	6982
1991	456	5418	2623	1513	872	10882

53. On the basis of the rate of growth of the population between 1951 and 1971 the number of houses are projected for the year 1981 and 1991 and/given in the following table. / are

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Table No. VIII-18

Projection of Population & Number of Houses

	Year 1971		Year 1981		Year 1991	
	Population	No. of Houses	Population	No. of Houses.	Population	No. of Houses.
Total	341858	55930	435416	71416	554688	90829
Rural	322229	52511	-	66920	523059	85220
Urban	19629	3419	24874	4496	31529	5609

54. The number of new houses to be constructed in the year, 1981 and 1991 will be 1548 and 1941 respectively.

55. Assuming the present rate of wood requirement for house construction and repairs the projected consumption of wood would be as under :-

Table No. VIII - 19

Total consumption for houses construction and repa m (m^3)

	Chir	Kail	Deodar	Fir/Spruce	Total
1970	-	4847	19390	-	24,237
1981	-	6,148	24,591	-	30,739
1991	-	7,764	31,058	-	38,822

56. WOOD CONSUMPTION FOR AGRICULTURAL IMPLEMENTS :

The rural character of th Indian society with agricultural population of more than 80% makes it necessary for the farmers to use hand made and self-fabricated tools, carts and other implements. There is very little likeli-hood that the situation will change in the near future.

57. As there is no historical series on the wood consumption an elasticity co-efficient for the countries in the same income group, as India in the F.A.O. study for the World indicative plan has been used, in these calculations.

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58. CONSUMPTION FOR AGRICULTURAL IMPLEMENTS :

On the basis of the population projections for the year, 1981 and 1991, the number of agricultural households and corresponding increase in the number of ploughs and levellers is shown in Table No.20.

TABLE NO. VIII.20

Year	Item	Number		Wood required (m^3)
1981	Ploughs	61,437		8,601.18
	Levellers	3,187		478.05
			Total	9,079.23
1991	Ploughs	80,342		11,247.88
	Levellers	4,169		625.35
			Total	11,873.23

59. The species used for the purpose of agricultural implements are usually Oak, Mulberry, Ash, Apricot, Salix etc.

60. FORECAST FOR FUEL CONSUMPTION :

Fuel wood is an essential commodity and the growth in its demand is directly related with the growth in the population. Using the per capita consumption for the year 1971. The requirement during the year 1981 and 1991 will be as follows:-

Table No. VIII-21

Projected Consumption of Wood for fuel in (m^3)

	Chir	Kail	Deodar	Fir/Spruce	Broad leaved	Total
1970	207	1520	2026	9960	8011	21724
1981	319	2516	3048	16997	11991	34671
1991	495	3572	4659	26267	18671	53664

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61. CONSUMPTION BY OTHER DEPARTMENTS :

Variety of developmental activity in the area will definitely require wood for buildings and other purposes. Present wood consumption by these departments may not be able to indicate the future consumption. However, the demand for these departments has been forecast on these figures.

Table No. VIII - 22

Projected Consumption of Timber by other Department

	WRE(cubic metres)				
	Chir	Kail	Deodar	Fir/Spruce	Total
1971	28	52	142	18	240
1981	44	81	214	31	370
1991	68	125	337	49	579

62. FORECAST FOR THE COMMITTED EXPORT :

Committed export of timber from the area comprises of supplies to Railway & D.G.S.& D.

63. The demand figures separately for Railway &. D.G.S. & D. for any year are not available. Based on the available figures for supply to Railway, D.G.S.& D. out side the area the forecast for the years 1981 and 1991 are given below :-

Table No. VIII-23

Projected Consumption of timber by Railway & D.G.S.&D.

	WRE (cubic meters)					
	Chir	Kail	Deodar	Fir/Spruce	Broad leaved	Total
1970	924	307	3191	5449	-	9871
1981	1424	460	4846	8419	-	15149
1991	2139	668	7501	12823	-	23184

64. A summary of Projected demand for timber and fuel wood for the year 1981 and 1991 is given in the following table.

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Table No. VIII -24

SUMMARY OF PROJECTED DEMAND OF TIMBER AND FUELWOOD IN THE ZONE

A. Timber		Units	Cubic metres(WRS)
Species	1970	1981	1991
Chir	1143	1760	2713
Kail	7502	10158	13975
Deodar	23839	31340	41200
Fir/Spruce	6106	9425	14388
Broad leaved	7354	9637	12745
Total	45941	62320	85021
B. Fuel Wood			
Chir	207	319	495
Kail	1520	2316	3572
Deodar	2026	3048	4659
Fir/Spruce	9960	16997	26267
Broad leaved	8011	11991	18671
Total	21724	34671	53664
Grand Total	67668	96991	138685

CHAPTER - IX

W O O D B A L A N C E S

Present Consumption and Projected Demand

9.0 The present consumption and the projected demand of timber and fuelwood in the area is summarised in the following table :- (Cf. Chapter VIII - Market and Demand Studies).

Table No. IX - 1

Present consumption and the projected demand of timber and fuelwood in the Zone in m^3

Species	YEARS 1970	1981	1991
	(Cubic Meters)		
A. TIMBER			
Chir	1,143	1,760	2,713
Kail	7,502	10,158	13,975
Deodar	23,839	31,340	41,200
Fir/Spruce	6,106	9,425	14,388
Broad leaved	7,354	9,637	12,745
Total	45,944	62,320	85,021
B. FUEL WOOD			
Chir	207	319	495
Kail	1,520	2,316	3,572
Deodar	2,026	3,048	4,659
Fir/Spruce	9,960	16,997	26,267
Broad leaved	8,011	11,991	18,671
Total	21,724	34,671	53,664
Grand Total	67,668	96,991	1,38,685

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2. WOOD BALANCES :

The Balance of coniferous woods after meeting the local demands under the two Models, therefore, works out as below :-

Table No. IX - 3

Showing Wood Balances (000 m^3)

Species	YEARS 1970 Models		1981 Models		1991 Models	
	I	II	I	II	I	II
Fir/Spruce	267	340	257	330	243	316
Deodar	277	277	269	269	257	257
Kail	198	269	195	266	189	260
Chir	38	48	37	47	36	46

Note :- Broad leaved species have been left out of calculations (Cf. Chapter VII).

3. Assuming that deodar will be felld only to the extent for meeting the requirements of the local people and surplus if any will be exported out of the area, for uses other than paper and pulp the total volume available for industrial purposes from Fir/Spruce, Kail, Chir will be as follows :-

Table No. IX-5

Wood available for Industrial purposes (000 m^3)

(Fir/Spruce, Kail & Chir)

MODEL	YEARS 1970	1991	199.
I	503	489	468
II	657	643	622

4. Further, assuming that it may take 10 to 15 years to establish a pulp and paper mill or any other wood based industries on a large scale in the area it is proposed that the wood balances as available in the year 1991 should only be considered for industrial purposes.

5. Thus the coniferous wood available for industrial purpose from Fir/Spruce, Kail and Chir under the two Models will be :-

Model	Volume (000 m^3)
I	468
II	622

6. Entire quantities of coniferous raw materials may not be fully available for utilization on account of the silvicultural requirements of the crop inaccessibility of the terrain, inefficient logging techniques and several other factors. To be on the safe side let it be presumed that only fifty percent of these wood balances will be available for industrial purposes. The quantities available under the two models will, therefore, be as follows :-

Model	Volume (000 m^3)
I	234
II	311

NK SHARMA/

CHAPTER - X

ACCESSIBILITY AND COST STUDIES

1. DELIVERY SITE :

Jammu had been tentatively selected as the delivery site for industrial utilization of the wood from the Valley.

2. OBJECTIVES :

The object of the Studies was to determine the availability of the raw material and delivery costs, at the proposed sites.

This study also aimed at determining the distribution of the growing stock/potential cut in broad cost classes at which, the available material can be delivered at the proposed site for industrial utilization, i.e. total available volume was required to be grouped into various cost classes for delivery at Jammu.

3. The costs considered in the report do not include the stumpage or royalty payable to the state.

4. FACTORS INFLUENCING LOGGING AND TIMBER TRANSPORT COSTS

In addition to topography, drainage, rail & roads and climate, that have already been described, the other factors that influence logging cost, are :-

AVAILABILITY OF :

(a) Labour

(b) Devices, tools & implements used in logging & minor transport of timber.

5. AVAILABILITY OF LABOUR :

Sufficient local Kashmiri labour is available for felling, rough fashioning, sawing and carriage of timber except during sawing season. Some labour is imported from Kulu and Kangra areas of Himachal Pradesh for specialised jobs like Gravity Ropeways and river floating of timber. The percentage of imported labout for items involving special skill constitute about 5% to 10% of total labour employed on various logging operations. The labour wage rates range from Rs.5/- to Rs. 7/- per day

6. LOGGING DEVICES USED FOR FELLING AND MINOR TRANSPORT

Conventional tools like two men cross - cut saws and axes are used for felling and conversion. Various minor transport models are used, depending

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upon the location of the area. Rolling is the only minor transport means adopted for logs. Sky line cranes have not been put to use in this area. Smaller converted material like sleepers and hakaries are brought down from the logging area to launching/loading point by any one or combination of more than one mode of minor transport like manual carriage, dry slide, wet slide, telescopic floating and/or Donald Gravity ropeways. Donald Gravity Ropeways is extensively used in areas within the easy reach of the roads because it is quicker and cheaper mode of transport of timber and the material undergoes the least damage during the transport. A few lessees have however recently started using power driven Lasso Gravity Ropeways for transporting sleepers and hakaries.

PRESENT LOGGING PRACTICES IN THE AREA

7. LOGGING MANAGEMENT :

At present, the commercial extraction is confined only to the coniferous species with an average removal of about 65 m^3 per hectare . Within the logging area laying out the coupes and marking of the trees, as prescribed in the working plan, is carried out by State Forest Department. A coupe usually consists of a single compartment or a group of contiguous compartments/ sub-compartments. The commercial area of a coup ranges from 150 to 1900 hectare, average coupe is about 600 hectares.

The marked coupes are usually sold in auction sales to contractors. The successful bidders undertake the entire logging operation from forests to the utilization centres, including the sales. The contractors pay the royalty to the Forest Department & get the profit or suffer the losses. Most of the contractors engage sub-contractors for executing different logging operations. The lease or the working period varies from 1 to 9 years depending upon the extent of work involved and the size of the coupe.

During 1971, departmental extention has been started over a small area in Bhadarwah Forest Division. This activity may gradually extend to other areas.

8. LOGGING AND TIMBER TRANSPORT METHODS :

From Chenab Valley bulk of the timber extracted is in the form of sleepers and hakaries. Logs are also extracted from forests on easy slopes, where from these can be rolled down to launching or loading points. Fuel wood is not extracted from these forests on any Commercial scale. Axes and cross cut saws are used for felling and conversion. Some of the contractors have been using portable saw-mills for sawing of scantlings.

9. METHODOLOGY

(i) The study has been conducted on a systematic sampling design. Block centre of selected block of ground sampling design has been taken as a starting point for extraction. The Block Centre is also taken as the point of origin for compiling transport distances under minor and major transport modes.

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(ii) The costs on account of various logging operations were derived by conducting case studies in 25 logging coupes, representing the entire range of variations in topography and other working conditions in the Survey area.

(iii) With the help of carefully designed questionnaires and proformas, specially trained crews interviewed the forest lessees and sub-contractors who were engaged in the logging work in coupes selected for cost studies.

(iv) Detailed study of 1:50,000 topographic sheets was made. A specially trained officer was employed to judge the feasible and economic modes of transport from each point to Jammu.

(v) In an attempt to design the transport pattern from each point, first of all the minor transport modes were tried to be fitted. When it was found impossible to lay down any of the minor transport patterns, the point/plot was classified as in-accessible

(vi) Whenever, a number of alternatives fro minor and major transport modes for a particular Block Centre, were available only the cheapest alternative was selected for study.

(vii) For all the accessible points, the transport lay out on the map was carried out keeping in view the rolling gradients for various modes. To this layout 200 meters of haulage by manual labour on adhoc basis were added to account for local haulage.

(viii) By applying the costs per cu.m/Km. to the distances by various modes for the sample point and adding up we get the transportation cost/cu.m. upto the delivery site i.e. Jammu. This cost was increased by 10% for provision of amenities to labour.

(ix) The data so collected was cross checked and improved by direct investigations and making extensive use of the experience gained by the staff while carrying out similar studies in Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh and by departmental timber extraction units of Jammu and Kashmir and Himachal Pradesh.

(x) The entire objective was to work out the extraction costs which include felling, logging, sawing and transportation for each sample point (Block centre) and attaching to it a certain volume availability depending upon the volume in forested plot of the Block. The Blocks with the same cost class were grouped together and the total volume under that cost class was worked out, depending upon the total number of forested plots therein and the weight per plot for area and volume.

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L O G G I N G C O S T S

10. MARKING OF TREES FOR FELLING :

(i) The information was collected from 21 case study coupes, for direct costs incurred by the department on stores and labour employed on marking of trees. The information for total costs and the number of trees of different sizes marked for felling was obtained from the Divisional Forest office records and the abstracts of marking lists. Only major markings were considered.

(ii) The expenditure on technical labour has not been included in the calculations. It will be taken care of under the ' Overhead Charges '.

(iii) The cost per tree remains constant irrespective of variation in size as the labour involved for marking every tree is more or less the same.

(iv) Cost of marking per m^3 has been worked out by following two methods :-

(a) By assuming the average cost of various sizes

The cost has been worked out by assuming 70 Cms. as the average dbd. of marked tree. Case study reveals that the average cost of marking a tree is Rs.0.10. Therefore, the cost/m^3 works out to Rs.0.025 for an average tree with 4.18 m^3 of volume.

(b) By taking the average cost of various sizes

The following table shows the cost of marking on trees of different diameter classes :-

Table No. X- I

Dia.class in cms.	Average Vol./ Tree Cu.m.	Cost of marking per tree (Rs.)	Cost/Cu.m. (in Rs.)
90	10.40	0.10	0.010
75-90	6.70	0.10	0.015
60-75	4.18	0.10	0.024
45-60	2.25	0.10	0.044
30-45	0.93	0.10	0.107
30	0.27	0.10	0.370

Note : The volume of average tree for each diameter class has been computed from special studies involving actual fellings of trees.

Contents

The above table shows that there is a linear relationship between the diameter and marking cost/m^3. With the increase in dbh, the marking cost/m^3 decreases.

The average cost of all size trees works out to Rs.0.C95/Cu.m. This hold good only when the trees of all diameters are taken in equal proportion for marking. The average cost is boosted up because of very low volume contribution by lower diameter classes especially below 45 cms. At this stage, the proportion in which the trees of various sizes will be harvested is not clearly known. But it is expected that the major portion of the Yield will be derived from trees above 45 cms.dbh. For average, the marking cost was worked out by taking into consideration the average dbh, as 70 cms.

It is therefore decided to adopt the cost arrived at by the first method i.e. Rs.0.025/ m^3.

11. FELLING (INCLUDING LOPPING AND ROPING)

(i) Felling is mostly carried out by saws. The payment is normally made on per tree basis, depending on the diameter of the tree.

(ii) Most of the lessees pay separately for lopping and roping wherever it is done. Some of them treat these two operations as a part and parcel of felling operation and fix the felling rates inclusive of lopping and roping.

(iii) For the sake of this study it has been decided to apply 50% and 30% of average lopping and roping rates respectively, for calculations and merge this cost with felling cost.

(iv) From the case study data, it has not been possible to find out the effect of logging density on the cost of felling. Elaborate time studies are required to determine the effect of logging density on the cost of felling. However, it is expected that very little effect of this factor can be felt in the cost of felling with the relative low performance of labour in manual working.

(v) Separate average felling costs were worked out for each forest division to find out if there is any distinct cost variation in different localities. The study reveals that there is no significant difference in the felling cost per tree under various diameter classes in different division, except in case of Ramban Division where the cost is about 15% lower than other Divisions, presumably due to better road communications and nearness of working areas to habitations. Over 90% of the growing stock is found in the remaining three divisions namely Doda, Bhadarwah and Kishtwar. At the same time it is expected that the interior forest areas of these divisions would be gradually opened up with better communications when large scale industrial

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exploitation starts. It is, therefore, decided to take a general average felling cost derived from the studies carried out in the entire area for calculations.

(v (v) The diameter class wise felling rates are given in the following table :-

Table No. X-2

DIAMETER CLASSWISE COST OF FELLING LOPPING AND ROPING

Dia. Class	Felling cost/tree (in Rs.) Felling	Lopping and roping	Felling including lopping & roping.	Felling cost/Cu.m.(in Rs.) Felling	Lopping and roping	Felling including lopping & roping.
90	11.79	1.76	13.55	1.13	0.17	1.30
75-90	5.43	1.30	6.73	0.81	0.19	1.00
60-75	3.39	0.87	4.26	0.81	0.21	1.02
45-60	2.41	0.61	3.02	1.07	0.27	1.34
30-45	1.19	0.45	1.64	1.28	0.48	1.76
-30	0.44	-	0.44	1.63	-	1.63

Note :- i) Lopping and roping costs shown in the table are 50% of average lopping cost and 30% of average roping cost recorded in case studies.

ii) to find out the cost/cu.m the average volume/tree for each diameter class is taken from Table- 1.

(vii) These felling rates compare favourably with the schedule of rates presently being followed by lumbering Division of the Department Lumbering Project in Chenab catchment. Felling rates derived from the case studies are compared to those of Departmental Lumbering Project Schedule in the table below :-

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Table No. X-3

COMPARATIVE COST STATEMENT OF CASE STUDI S AND D.L.P. SCHEDULES.

Dia. Class (in cms.)	Felling cost/tree (in Rs.)	
	D.L.P rates	Case studies (average)
90	10.20	11.79
75–90	5.00	5.43
60–75	2.75	3.39
45–60	2.00	2.41
30–45	1.00	1.19
-30	0.40	0.44

(viii) Thus the average felling cost (including lopping and roping cost) irrespective of size works out to be Rs.1.34/m^3. Since the bulk of yield is expected to be derived from trees of 45 cm. dbh. and above, it has been decided to take the average felling cost of diameter classes above this dbh. limit and it works out to Rs.1.17/m^3.

12. BUCKING AND LOG MAKING

(i) Apart from cross cutting of felled trees into logs, this operation also includes delimbing and debarking. Cross cutting of felled trees into logs of required length is carried out by cross-cut saws. Delimbing and debarking operations are done with the help of axe. The log length is normally 3 to 5 meters.

(ii) The costs/m^3 as worked out from 14 case studies was Rs.3.92/m^3 of log volume.

13. SLEEPER MARKING :

Logs or trees as such, are further converted into sleepers by (i) Hand Sawing and (ii) Machine Sawing.

(i) HAND SAWING :

Hand Sawing is usually done at the felling site itself. This is a very wasteful method in which only about 50% of the material is recovered from the logs. Normally the sleeper making work is carried out on piece meal payment basis.

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The average cost of conversion worked out from case studies was Rs.33.26 m^3 of sawn volume.

(ii) MACHINE SAWING :

In areas where communications are better, some contractors instal portable saw mills in the coupe for conversion of logs into sleepers/scantlings. The logs are rolled down/brought to the Saw Mill site & making of sleepers & scantlings is done.

Machine sawing is cheaper than hand sawing and it involves lesser conversion waste. The conversion percentage was as high as 60% to 65% of the log volume. The cost of conversion was Rs.19.57/m^3 plus Rs.2.22/m^3 on account of depreciation of equipment, the total covers to Rs.21.79/m^3 of sawn volume.

14. HAKARI MAKING :

(i) Hakari is a term used for split wood of irregular shape. Logs, not fit for sleeper making, are split into hakaries for convenience of transport. The length of hakaries varies from 1 metre to 3 metres though mostly these are 1.2 metres to 2 metres in length.

(ii) For calculation purposes the average length of hakari is taken as 1.8 metres. For payments, volume of 3 hakaries is treated equal to the volume of 2 B.G. sleepers by the lessees. In the absence of any other standard volume factor, the calculations are based on the above assumption by which the forest lessees record the volume out-put.

(iii) The average cost works out to be Rs.12.93/m^3 for the converted volume from the case studies.

15. ENGRAVING PROPERTY MARK :

(i) This operation consists of engraving the property mark on two faces of logs/scants before they are transported from the forest or are launched into the river/stream. In case of logs this cost includes the cost of sniping the edges also, where as sniping cost in case of sleepers etc. is included in conversion cost. The payment is made on piece meal basis.

(ii) Assuming an average volume of 1 m^3 per log, average cost for logs works out to be Rs.0.18/m^3 of log volume and Rs.0.30/m^3 of sawn volume for sawn timber.

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MINOR TRANSPORT COSTS

16. The minor transport includes (a) rolling of logs (b) manual carriage (c) dry slides (d)wet slides (e) telescopic floating and (f) gravity ropeways, for off road transport of scantlings.

17. (a) ROLLING OF LOGS :

(i) This method is generally adopted in the for sts for the transport of logs which cannot be carried on human back. Rolling of logs is generally done over short distances not exceeding 3 Kms. For longer distances it is expensive as well as sometimes impracticable.

(ii) Cost of rolling varies considerably with the terrain, size of the logs, the distance over which it is transported and the skill of labour.

(iii) Cost of rolling of logs worked out to be Rs.7.87/m^3/Km. of the round volume of logs.

18. (b) MANUAL CARRIAGE :

(i) Sleepers, scantlings and haka ies are carried on human back from the forest to the ropeway head, launching depot or road head etc. This method of transport is expensive and is resorted to only for shorter distances of 2 Kms. to 3 Kms.

(ii) On the basis of 12 case studies, average cost/m^3 of sawn wood over one Km. of distance transported was Rs.8.62.

19. (c) DRY SLIDES :

(i) Dry slides are trough shaped structures constructed out of sawn timber roughly fastened together for sliding down of timber where no water is available. The gradient varies from 1:4 to 1:7. Dry slides are usually constructed over short distances. The timber is carried manually to the slide head and then let down in the slide. Only down hill transport is possible in this method. Timber may be damaged due to friction and striking.

(ii) Average cost/m^3/Km. of the slide length for sawn timber was Rs. 3.68.

20. (d) WET SLIDES :

Wet slides have been used in this area for a long time. In the upper reaches of streams where water is scarce and floating is not possible, trough shaped slides are constructed out of sawn wood and water is let in these slides as lubricant and as a motive power in addition to gravity. This method of transport, saves damage to the timber. This method is also used for short distances, in sections.

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The cost of transport in wet slides ranged from Rs.1.51/m^3/km. the average being Rs. 1.94/m^3/km. (Sawn volume) of wet slide length.

21. (a) TELESCOPIC FLOATING :

(i) This method of floating is adopted to bring down sleepers and scantlings in side streams characterised by boulderry beds with great variation in gradient that creates difficulties for unobstructed free floating. In this method , a system of series of dams and slides are used for coursing the water and making aqueducts over obstacles for passage of water, The ducts and slides are comparatively much wider than wet slides, these are not fastened and allow free floating of timber. The tail of the timber used in slides and dams is ' telescoped' in hence the name.

(ii) The lead over which the telescopic floating is being carried in the Chenab area varies from 7 Kms. to 45 Kms. The cost varies from Rs.0.88/m^3 to Rs. 2.12/m^3 with an average of Rs. 1.31/m^3 (sawn volume) per km. of floating distance.

22. (f) DONAID GRAVITY ROPEWAYS:

(i) Donald Gravity Ropeway consists of two or three load carrying ropes, usally of 8 mm. diameter, called track rope, fixed between leading and unleading stations and an endless continuous wire rope of 6 mm. diameter, known as control rope. The lead rolls down by gravity with pulleys moving on the track ropes and is also attached with a wire to the control rope. The speed of the load is controlled by a hand operated brake provided on the controlled rope pulley at the lower station. The spans of the ropeways go upto 1,500 metres. About 750 metres to 1,000 metres span is considered ideal. The ropeways can operate on wide range of slopes from 15°to 45°, ideal being 22° to 35°. The safe working lead is about 0.25 m^3. The ropeway spans are most often in series.

(ii) This system is very popular with the forest leasees as it brings down the timber without fuel or power under gravitational force. It is easy, quick, efficient and cheap.

(iii) About 10 case studies were conducted for carriage cost by this mode. They were classified into following two categories :

(a) Cases with less than 750 meters of average span.

(b) Cases with average span of 750 meters and above.

(iv) The case studies indicate that the cost of carriage goes down with the increase in span length. Depending upon the length of the span, the rate/piece per span varies from Rs.0.14 to Rs.0.20. The average carriage cost per m^3 per Km. of span length including depreciation of equipment workout to Rs. 4.49 and Rs. 2.60 for spans over and less than 750 meters respectively.

MAJOR TRANSPORT

23. FREE FLOATING :

(i) Free floating of timber (both the sawn timber and logs) is most commonly done in Marau and Chenab, the two main rivers of the area.

(ii) Log transportation is at present mostly confined to forest areas from where logs can be rolled down to river side for launching. Logs are floated down to Akhnoor where they are caught and transported to Jammu by road. Boom at Ramban is not fit for catching of logs.

(iii) The best time for floating logs is between May and September when there is maximum water flow. September to October is the ideal time to launch scantlings in the river.

(iv) Timber floated down the rivers is collected either at Ramban or at Akhnoor. On account of heavy incidence of timber losses between Reasi and Akhnoor, the lessees have started collection of timber at Ramban. For Ramban they transport it by road to Jammu.

(v) The cost of free floating of scantlings has been worked out and is as under:-

a) Distance less than 100 Kms. Rs.0.15/m^3/Km.

b) Distance of 100 Kms. and more Rs.0.06/m^3/Km.

Since the log floating in Chenab is at present confined to areas with more than 100 Kms. lead, it has not been possible to study the influence of short lead on cost of floating. Cost of logs floating is Rs.0.08/m^3/Km.

24. ROAD TRANSPORT

Transport of timber by road is mostly done by 5 ton trucks. Cost of transport by road was assessed by (i) Direct enquiry (ii) Investment Studies.

(i) DIRECT ENQUIRY :

Lessees normally hire trucks for transporting timber to the market. A detailed study of hire charges from various loading points to the unloading points was carried out. The trucks in use are usually Tata Mercedes-Benz 5 tonners which carry about 7 m^3 of timber. The average cost /m^3/Km. by truck haulage is given in the following table :-

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Table No. X-4

AVERAGE TRUCKING COST DERIVED FROM CASE STUDIES

Cost in Rupees

Road Class	Average distance (in Km.)	Trucking cost/Cu.m/Km.(without loading & unloading costs).	Trucking cost/Cu.m/Km.(with loading & unloading)			Remarks
		Scants/Hakaries	Logs	Logs	Scants/Hakaries	
Class I (National Highway)	155	0.13	0.15	0.17	0.15	Jammu Srinagar Road Ramban Jammu Section
Class II	30	0-19	0.25	0.33	0.22	Akhnoor Jammu Section.
Class II	16	0.28	0.37	0.53	0.37	Bhadarwah Batote Section
Combination of Class I & Class II	187	0.15	0.18	0.19	0.16	Bhadarwah/ Kishtwar Jammu Section.

Note :- i) Truck carrying capacity.

a) Logs - 6.38 m^3 on all routes.

b) Scants - 8.49 m^3 on Jammu-Akhnoor section (Plains) and 7.08 m^3 on all other routes (Hills),

ii) Loading and Unloading cost.

a) Logs-Rs. 16.00 per truck

b) Scants-Rs. 8.70 per truck.

(ii) INVESTMENT STUDIES : If the agency engaged in extraction purchases its own fleet of trucks, the cost/cu.m/Km. would have to be worked out in a different way. The capital Investment in purchasing a 5 Ton T.M.B. truck (carrying capacity - 7 Cu.m.) is distributed over its life span and the average annual investment at 6% compound interest is worked out after deducting the scrap value at the end. For the purpose of calculation the following values were assumed, based on the cost structure and working conditions obtainable.

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1.	Truck type	Tata Mercedes Benz (5 Tonne)
2.	Cost of chasis	Rs.60,000.00
3.	Body construction	Rs. 6,000.00
4.	Scrap value	Rs. 5,000.00
5.	Interest on capital investment	6% per annum (compound interest)
6.	Life of the truck beyond which its maintenance becomes un-economical.	10 years.
7.	Fuel cost	1 Litre diesel per 3 Kms. run @ Rs.0.98 per litre.
8.	Lubricants.	1 Litre/100 Kms. run @ Rs.3.50/Lt.
9.	Repairs and Maintenance	Rs. 6,600/- per year
10.	Insurance, route, permit, taxes etc.	Rs. 3,600.00 per year
11.	Carrying capacity	7 Cu.m.
12.	Pay and allowances of driver and cleaner	Rs.7,300.00 per year
13.	Loading and unloading	Rs.13/- per truck load.
14.	Terminal time (loading and unloading and routine delays)	2 Hours/trip.
15.	Average speed	30 Kms./per hour
16.	Total operating time	10 Hours/day.
17.	Total No. of working days.	250 days/Year.

To the average annual capital investment (yearly instalment) the interest due to scrap value and the recurring annual expenses for running and maintenance (including the driver and cleaner's salary) have been added to get the total annual expenditure. For various haulage distances from 15 to 180 Kms. the trips per day and

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and the total trips per year have been calculated to compute the total volume transported in a year. From this, the total cost/Cu.m/Km. for various distances were computed and are given in the Table X -5.

TABLE NO. X-5

TRUCKING COSTS INCLUDING LOADING AND UNLOADING FOR AN AVERAGE TRAVEL SPEED OF 30 KM. PER HOUR.

Haulage distance (in Kms.)	Total cost/Cu.m (in Rs.)	Cost/Cu.m/Km. (in Rs.)
15	7.93	0. 53
30	10.92	0.36
45	13.96	0.31
60	16.97	0.28
90	23.08	0.26
120	29.16	0.24
150	35.31	0.23
180	41.45	0.23

A study of the above two tables would indicate that the cost/Cu.m/Km. for haulage by road would be cheaper if the trucks are hired for transport. The haulage in the second method would be expensive as the truck is used for transporting timber during the onward journey of the trip (trip being the journey from the loading point to the unloading point and back). On its return journey to the forest, the truck is not carrying any load. However, it could be used for transporting provisions, labour etc. as is done by hired trucks.

If extraction has to be carried out for industrial purposes, the quantum of wood to be moved would be of such a magnitude as to require a regular transport fleet owned and maintained by the extraction agency itself. This may be cheaper than what has been calculated above, even though it may be still more expensive than the hired trucks. This increased cost would be adequately compensated by speed of carriage, resulting in more efficient utilization & production and over all returns from the capital invested.

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This report has been prepared for evaluating the cost involved in procuring raw material for industrial purposes. As such, the road transport costs as calculated in the second method i.e. investment studies, have been used for calculation.

25. AMENITIES TO LABOUR

(i) Certain amount of expenditure has to be incurred in providing amenities to the labour employed on logging operations.

(ii) The labour camps are set up by the labourers in the working areas. They are paid for the period spent on setting up camps, on daily wages basis, even though there is no production.

(iii) During the period of working, provisions in all the cases and medicines in some of the cases are made available to the labour in the camps at subsidised rates.

(iv) It has not been possible to assess the exact quantum of expenditure involved in providing the above amenities to the labour. Never-the-less this item cannot be ignored. The schedule of Departmental Lumbering Project, Jammu and Kashmir, provides for additional 10% payment to the labour on account of the amenities referred to above. To account for these amenities the costs on all operations, excluding marking and "major Transport", increased by 10%.

26. OVER-HEAD CHARGES :

The extraction operations require supervision and administration at various levels by the technical staff engaged by the State Government and the lessees. The technical personnal so employed have multifarious duties to perform and are not engaged in the administration and supervision of a specific area under logging alone. It is not easy to calculate the expenditure attributable to this item. However, in general, 10% of the total logging cost is accepted as over-head charges on the account (Departmental Lumbering Divisions of Himachal Pradesh).

In these calculations, the over-head charges have been accounted for by increasing the total logging cost by 10%.

27. SUMMARY OF COST/m^3 FOR VARIOUS OPERATIONS :

	Item	Average Cost/m^3 (in Rupees)
1.	Marking of trees	0.025 (Standing volume)
2.	Felling (including roping and Lopping)	1.17 (Standing volume)

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3.	Bucking (Delimbing, cross-cutting and debarking)	3.92 (Log Volume)
4.	Sleeper conversion	
	i) By hand sawing	33.26 (Sawn volume)
	ii) By machine sawing.	21.79 (Sawn volume)
5.	Hakari making	12.92 (Split volume)
6.	Engraving property mark	0.30 (Scant volume)
	i) Sleeper/Hakaries	0.18 (Log volume)
	ii) Logs.	
7.	Minor transportation:	Av. cost /M³/Km.
	i) Rolling (logs only)	7.87
	ii) Manual carriage	8.62
	iii) Dry slide	3.86
	iv) Wet slide	1.94
	v) Telescopic floating	1.31
	vi) Donald Gravity Ropeways	2.60 (Span 750 meters and more)
	vii) Donald Gravity Rop-eway	4.49 (Span less than 750 meters)
	viii) Power Ropeways	3.89
8	MAJOR TRANSPORATATION	
	i) Free floating	
	a) Logs	0.08
	b) Sleepers/Scantling/Bakaries :	
	1) Lead below 100 Kms.	0.15
	2) Lead of 100 Kms. and more	0.06
	ii) Trucking :	
	a) 1-15 Kms. lead	0.53
	b) 16-30 Kms. lead	0.36
	c) 31-45 Kms. lead	0.31
	d) 46-60 Kms. lead	0.28
	e) 61-90 Kms. lead	0.26
	f) 91-120 Kms. Lead	0.24
	g) 121-150 Kms. lead	0.23
	h) 151-180 Kms. and above lead	0.23

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9.	Amenities to labour	10% on all items from 2 to 7 (i to vii) above.
10.	Over-head charges	10% on items 1 to 8

28. COST ANALYSIS FOR WOOD EXTRACTION

The total available volume has been grouped into various cost classes with respect to its delivery at Jammu. Stumpage or Royalty payable to the State has not been included.

29. Distribution of volume (growing stock) and its percentage by different cost classes for delivery at Jammu are given in Table X-6 under the following alternatives :-

I. The material is extracted as logs form wherever possible and in the sawn form (Hand Sawn) from the rest of the area.

II. The material is extracted as logs form wherever possible and as Hakaris from the rest of the area.

III. The material is extracted as Sleepers from all over the area.

IV. The material is extracted as Hakaris from all over the area.

TABLE NO. X-6

CHENAB VALLEY - COST STUDIES

VOLUME DISTRIBUTION IN COST CLASSES FROM THE ACCESSIBLE BLOCKS

All Volume in (1000 cu.m.)

S.NO.	Cost Class Rs.	Volume in the class if extracted as LOGS: Volume in Class	LOGS: Cummulative Volume	LOGS: Cummulative %	Logs where possible and sleepers elsewhere: Volume in Class	Logs where possible and sleepers elsewhere: Cummulative Volume	Logs where possible and sleepers elsewhere: Cummulative %	Logs where possible & bakaries elsewhere: Volume in class	Logs where possible & bakaries elsewhere: Cummulative Volume	Logs where possible & bakaries elsewhere: Cummulative %	SLEEPERS: Volume in class	SLEEPERS: Cummulative Volume	SLEEPERS: Cummulative %	BAKARIES: Volume in class	BAKARIES: Cummulative Volume	BAKARIES: Cummulative %
1.	0-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	11-22	430	430	2.4	430	430	0.8	430	430	0.5	-	-	-	-	-	-
3.	21-30	3,732	4,162	23.5	3,732	4,162	7.4	3,732	4,162	4.6	-	-	-	430	430	0.5
4.	31-40	4,336	8,498	48.0	4,336	8,498	15.1	5,741	10,903	12.0	-	-	-	10,882	11,312	12.4
5.	41-50	6,125	14,623	82.6	6,125	14,623	26.0	24,080	34,983	38.4	-	-	-	26,747	38,069	41.8
6.	51-60	1,250	15,873	89.7	1,250	15,973	28.2	18,768	53,751	59.0	226	266	0.5	17,518	55,577	61.0
7.	61-70	1,826	17,699	100.0	2,940	18,813	33.4	17,965	71,716	78.7	2,705	2,931	6.1	16,139	71,716	78.7
8.	71-80	-	-	-	6,384	25,197	44.7	12,705	84,421	92.7	13,881	16,812	35.1	12,705	84,421	92.7
9.	81-90	-	-	-	11,638	36,835	65.4	14,407	88,828	97.5	11,638	28,450	59.3	4,407	88,828	97.5
10.	91-100	-	-	-	7,171	44,006	78.1	2,274	91,102	100.0	7,171	35,621	74.5	2,274	91,102	100.0
11.	101-110	-	-	-	8,005	52,011	92.3	-	-	-	8,005	43,626	91.0	-	-	-
12.	111-120	-	-	-	3,125	55,136	97.9	-	-	-	3,125	46,751	97.5	-	-	-
13.	121-130	-	-	-	1,197	56,333	100.0	-	-	-	1,197	47,948	100.0	-	-	-

CHAPTER - XI

I N D U S T R I A L P O S S I B I L I T I E S

Considering that 1.5 m^3 of wood is equal to one tonne in weight, the available wood in tonnes per annum for industrial purpose, in the two Models would be :

Model I	156,000 tonnes
Model II	207,000 tonnes

Assuming 300 working days in a year, the calculated capacities of mills that can be set up for different kind of pulps are given in the table belwo, for the two cutting Models that have been considered.

Table No. XI-1

Calculated capacity of pulp mills in tonnes/day based on raw materials available from the Zone under the Two Models

S.NO.	Kind of Pulp	Yield	Capacity in tonnes/day	
			Model I	Model II
1.	Ground wood	90%	468	621
2.	Semi Chemical	70%	364	483
3.	Chemical (Kraft)	40%	208	276
4.	Chemical (Royon Grade)	30%	156	207

NK SHARMA/

CHAPTER - XLI

R E C O M M E N D A T I O N S

I. INSTALLATION OF PULP AND PAPER MILL

Wood suitable for installation of pulp mill of the capacities as calculated in table XI-1, are available, under the two Models considered. Other aspects regarding selection of site, availability of power, transportation of chemicals and many other important factors be got investigated.

II. REMOVAL OF CULL :

The studies have indicated that Deodar and Chir have almost no cull. Fir and Kail have a sizeable quantity of defective growing stock which cannot be put to any use. The percentage of cull becomes much more significant with the increase in the size/age of the trees.

It is, therefore, necessary that dead, diseased and the over-mature trees of all these species should be liquidated on top priority basis so as to stop the negative increment in these forest.

III. - LOGGING :

For efficient and fuller utilization of the wood from these forests mechanised means be introduced for felling, cross cutting, saving and off-road transport.

The objective should be to extract maximum quantities of wood at the cheapest cost as far as possible. To achieve this, there can be a balanced blending of mechanised means and conventional methods of logging.

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IV. MEANS OF COMMUNICATION

Infra-structure with respect to means of communication is very poor in this area. For overall development of the area, extraction of wood, raising of plantations and for other forestry developmental works, it is essential that appropriate road planning programmes are undertaken at the earliest possible time.

V. REGENERATION :

Artificial means of regeneration have to be adopted to augment natural regeneration of Fir/Spruce, Kail forests and even Deodar and Chir in refractory areas, and for afforestation. Closures to grazing would be necessary for successful plantation programmes.

For this purpose, the work of raising of the nurseries and research, if required, be under-taken well in advance before the large scale fellings can be done for feeding the proposed pulp mill.

VI. MANAGEMENT PRACTICES

For the time being Fir and Kail forests may continue to be managed with the objective of the production of large sized timber. On finalization of the proposal for pulp industry, these forests shall have to be managed on concentrated regeneration systems to produce 40 cm. diameter trees for pulp wood and timber for fruit packing cases. The Silvicultural System to be used will depend on the requirements of the species and site depending on the other factors available at that time.

NK SHARMA/